A STUDY OF THE CRYSTAL CHEMISTRY, CATHODOLUMINESCENCE, GEOCHEMISTRY AND OXYGEN ISOTOPES IN SCHEELITE: APPLICATION TOWARDS DISCRIMINATING AMONG DIFFERING ORE-DEPOSIT SYSTEMS

by

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ABSTRACT

Scheelite ($CaWO_4$) from a total of 37 of world-wide, differing ore-deposit settings (orogenic, sediment- and greenstone-hosted, skarn, porphyry, greisen, volcanogenic massive sulfide, breccia and polymetallic deposits) were examined using cathodoluminescence, SEM-EDS, LA-ICP-MS and whole-grain stable isotopic analyses. The goal of this study was to assess whether the crystal-chemistry of scheelite (i.e., major, minor and trace elements, stable isotopes, CL response) could be used to distinguish between differing environments of formation. Results show: (1) weak to strong CL responses, these varying from grains with complex, oscillatory zonation patterns, to discordant patterns to those where no zonation is evident; (2) the predominant elemental substitutions involve As^{5+} or $Mo^{6+} \leftrightarrow W^{6+}$, and Sr^{2+} or $REE^{3+} \leftrightarrow Ca^{2+}$; (3) the trends in REE vary in terms of ΣREEs (10^4 range in CN values). The degree and type of REE fractionation patterns (flat, convex, concave) are variable and both positive and negative Eu anomalies (<0.1 to >20-30) may be present; and (4) the $\delta^{18}O$ values are highly variable, ranging from -4.6 to +12.7‰. The broad ranges do not independently fix a single parent fluid during scheelite formation. The intensity of CL zonation was found to correlate with Mo content: increases in Mo ↔ W substitution correlates with a reduction in CL signal. Further, the nature of the type zonation revealed by CL was found to directly correlate with geological environment: where zonation is absent (*i.e.*, a homogeneous CL response), the scheelite is associated with metamorphic-related systems and where the zonation is pronounced, the scheelite is associated with magmatic-related systems. The variability in REE patterns suggest that other factors are likely controlling the incorporation of REEs into scheelite (e.g., changes in fluid chemistry and mineral precipitation). The presence of substitutions involving Mo and As are particularly relevant, as both are redox sensitive. In particular, enrichments in Mo (>100 ppm) suggest formation in highly oxidizing environments wherein, Mo may be mobile. The crystal-chemistry of scheelite has been demonstrated to be both a strong indicator of ore-forming conditions and the general geological environment.

Keywords: scheelite, indicator mineral, cathodoluminescence, laser ablation ICP-MS, mineral chemistry, oxygen isotopes, ore deposits

CO-AUTHORSHIP STATEMENT

This thesis manuscript is the result of several collaborative projects in which co-authors provided supervision, scientific guidance and discussion and are therefore listed as co-authors for chapters 2 and 3.

As first authors of these chapters, I collected samples from archived suites in the geology departments and the Canadian Museum of Nature and Miller Museum, made petrographic analyses; prepared samples for geochemical analyses (*e.g.*, CL, LA-ICP-MS, oxygen isotopic analysis), processing of all the LA-ICP-MS data and developed the primary CL, mineral chemistry, oxygen isotopes and geochemical mapping interpretations by writing the first version of these chapters; and finally communicated with the journal editors from the submission through to the acceptance of the manuscript by the refereed scientific journal.

Both chapters are co-authored by my supervisors Drs. Andrew M. McDonald and Daniel J. Kontak whom provided scientific guidance and extensive feedback on the hypotheses, interpretations and writing style for chapters 2 and 3. Furthermore, Beth McClenaghan contributed by discussing the use and current methodology of indicator minerals.

The data presented within are my own unless otherwise acknowledged, and except where noted, all sample collection, preparation and analysis has been my own work.

Although considerable benefit was derived from discussions with acknowledged co-workers, the interpretations and conclusions presented in my thesis are my own.

Rémy S. Poulin

"Many of life's failures are people who did not realize how close they were to success when they gave up."

– Thomas A. Edison

To my family

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1:

INTRODUCTION

1.1. Overview

As part of the Geological Survey of Canada's (GSC) Targeted Geoscience Initiative (TGI-4) program, this project was developed to evaluate the potential use of scheelite as a resistant indicator mineral (RIMs) for base-metal exploration. This study follows similar research and procedures of other mineral phases (*e.g.*, garnet, chromite, olivine, clinopyroxene, and ilmenite), which have proven to be effective indicator minerals in the exploration industry (McClenaghan and Cabri 2011; McClenaghan *et al.* 2001, 2009, 2014).

Regional heavy mineral sampling, based on the recognition and analysis of RIMs in soil and till samples, is a widely accepted and applied technique to search for concealed or undiscovered ore deposits. This method is widely used and highly successful within the diamond exploration industry (*e.g.*, Averill 2001; McClenghan *et al.* 2000; McClenghan and Kjasgaard 2007). Regional heavy mineral sampling does, however, also offer potential application in the search for a range of other commodities for a variety of ore deposit types (*e.g.*, porphyry Cu, chromite, and base-metal mineralization) and this has been increasingly researched in recent years (*e.g.*, Boutroy *et al.* 2014; Dare *et al.* 2014; Song *et al.* 2014; Celis 2015; Xu *et al.* 2015). Although the processing cost per unit sample is high relative to some other geochemical exploration techniques, such as soil sampling or even a whole rock chemical analysis, the use of mineral chemistry provides insight into the genesis and chemical fingerprints relevant to the phase of interest. With this information, geologic processes and environments can be accurately determined. In short, some minerals can potentially be used as process discriminators.

The chemical analysis of single mineral phases can be an extremely sensitive indicator of processes of which has long been used by the geological community. For example, the major and minor element chemistry of certain minerals has been used to infer tectonic setting and source regions of magmas (*e.g.*, Pearce 1984, Rollinson 1993, McKenzie and O'nions 1995). Garnet chemistry has long been used to infer the nature and endowment of skarn deposit types (Meinert *et al.* 2005) and the application of a variety of minerals (garnet, chromite, olivine, clinopyroxene, and ilmenite) is used extensively in diamond exploration and assessing degree of fertility (*e.g.*, McClenaghan *et al.* 2001, Carmody *et al.* 2014). Ongoing research into the development of indicator minerals for other deposit types has in recent years seen the appearance of a variety of potential RIMs, perhaps the most widely researched being those for economic ore deposits.

Scheelite ($CaWO_4$) varies from a common to an accessory phase in a variety of hydrothermal ore-deposit settings, including Cu-Mo-W porphyry systems, skarns, and vein Sn-W. Scheelite is an economically important source of W and it can also, be an important indicator of ore minerals in other deposit types, such as Au systems, as it is present in a large variety of mineral deposit types. Furthermore, as scheelite is resistant to both chemical and physical weathering (*i.e.*, Mohs hardness = 4 - 5) and possesses a high specific density (5.9 - 6.12 g/cm^3) it is commonly encountered during overburden exploration. As part of the study into testing the applicability of scheelite as both a pathfinder mineral and a discriminator among different ore deposit types, scheelite from 37 ore deposits were examined using a variety of analytical methods to fully characterize and develop a chemical database [*i.e.*, trace elements, stable isotope ($\delta^{18}O$), cathodoluminescence].

This study presents the most comprehensive dataset for scheelite and suggests that there is a large variation in the parameters examined, which considerably expands the current state of knowledge for this mineral. The new data provides insight into the fluid evolution of ore deposits possessing a complex paragenesis and will serve to establish a basis for further applied crystal-chemical studies of this mineral phase. While this study has greatly expanded the state of knowledge and chemical database of scheelite, the key to its successful development as an indicator mineral lies with understanding its origins. Several chemical parameters can be determined through examining scheelite's rare earth element patterns, Eu anomalies, and Mo content and provide insight into its environment of formation. This study has shown that scheelite contains a plethora of information with regards to both its origins and that of its parent ore body. Mineral studies such as this should not be overlooked, as they can undoubtedly provide important information regarding specific ore deposits.

1.2. Organization of the thesis

This thesis consists of a general introduction that describes the rational, objectives, and methods for this project, followed by two manuscripts.

Chapter 2 entitled "On the spatial relationship between catholuminescence and the chemical composition of scheelite from geologically diverse ore-deposit environments" has been accepted for publication in *The Canadian Mineralogist* and was written by Poulin, R.S., McDonald, A.M., Kontak, D.J., and McClenaghan, M.B.. This first paper examines the relationship between the cathodoluminescence (CL) response and chemical composition of scheelite from a variety of ore-deposit settings (e.g., orogenic Au, skarn, porphyry-related, greisens, VMS) coupled with SEM-EDS, CL imaging, and LA-ICP-MS techniques.

Chapter 3 entitled "Scheelite through the looking glass: determining ore systems using geochemistry and oxygen isotopes" is formatted for submission to the journal *Geochemistry-Exploration, Environment, Analysis* and was written by Poulin, R.S., Kontak, D.J., McDonald, A.M., and McClenaghan, M.B.. This second paper explores the potential use of scheelite of an indicator mineral for base-meal exploration examining in detail the chemistry of scheelite. This paper greatly expands on the nature of cathodoluminescence (CL) focusing on the geochemistry of scheelite examining trace element data acquired using LA ICP-MS and also $\delta^{18}O$ data.

CHAPTER 2:

ON THE SPATIAL RELATIONSHIP BETWEEN CATHODOLUMINESCENCE AND THE CHEMICAL COMPOSITON OF SCHEELITE FROM GEOLOGICALLY DIVERSE ORE-DEPOSIT ENVIRONMENTS

2.1. Introduction

Scheelite ($CaWO_4$) is a common to accessory phase mineral in a variety of geologically diverse ore-deposit settings, including orogenic Au, skarns, porphyries, and greisens. It is the principle ore of W and can be an important indicator of Au mineralization (de Smeth 1985, Robert and Brown 1986a, b). As it is highly resistant to both chemical and physical weathering and has a high density (5.9 - 6.12 g/cm^3), it is commonly encountered in exploration programs that involve heavy-mineral analyses of overburden material. These factors thus combine to make scheelite an ideal pathfinder or indicator mineral in the exploration for ore deposits (Averill 2001).

Studies involving cathodoluminescence (CL) have proved useful in revealing subtle zonation features associated in a variety of minerals (*e.g.*, quartz, apatite, carbonates; McManus and Wallace 1992, Campbell and Henderson 1997, Kempe and Götze 2002, Redmond *et al.* 2004, Rusk *et al.* 2008, Müller *et al.* 2010) with specific ore-deposit settings. One particularly fruitful area of advancing research is to better understand the complex zonation present in various minerals by coupling data produced by CL with that from LA-ICP-MS analyses and maps. Doing so provides a mechanism by which spatial relationships involving specific CL responses and minor- or trace-element chemistry can be directly correlated.

The majority of geochemical studies conducted on scheelite have been directed towards understanding the crystal chemistry and elemental partitioning in the mineral using materials from a single locale (*e.g.*, Cottrant 1981, Gaft *et al.* 1999, Brugger *et al.* 2000*a*, *b*, Mair *et al.* 2006, Roberts *et al.* 2006, MacRae *et al.* 2009). In this contribution, data relating to the spatial distribution of minor and trace elements in scheelite, the nature of observed CL responses, and the relationships among these, are presented and discussed. The goal is characterize scheelite in detail, to demonstrate that such features can be useful in understanding the origin of the mineral in diverse settings and to aid in developing criteria to characterize scheelite when found in heavy-mineral concentrates. It should be noted that no spectral data on scheelite were collected in this study, owing to the plethora that currently exists in the literature (*e.g.*, Gaft *et al.* 2005, MacRae and Wilson 2008). While this study concentrates on the mineral chemistry of scheelite from four deposits, a yet unpublished companion paper will address a much larger data set of minor and trace element chemistry from 37 deposits world-wide, along with measured $\delta^{18}O$ data, in an effort to address the broader application of scheelite as a path finder mineral.

2.2. Background

2.2.1. Crystal chemistry of scheelite

Scheelite ($CaWO_4$) is tetragonal, space group $I4_1/a$, and its crystal structure (Morell 1978) has two unique cation sites: an [8]-coordinated site, in which alkaline earths and alkalis are accommodated (*e.g.*, Ca^{2+}, Na^{+}), and a [4]-coordinated site which accommodates highly charged, smaller cations (*e.g.*, W^{6+}, Mo^{6+}, As^{5+}, Nb^{5+}). Scheelite and powellite ($CaMoO_4$) form a complete solid solution through the substitution of W ↔ Mo, although the compositional range observed in minerals in more limited in the natural environment [*i.e.*, natural scheelite rarely contains > 4 mol % $CaMoO_4$ (≈ 1.4 wt % Mo); Klein and Hurlburt 1971, Hsu and Galli 1973, Tyson *et al.* 1988)]. Thermodynamic calculations indicate that end-member scheelite and molybdenite exhibit an overlapping field of stability in terms of $fO_2$and fS_2 under normal crustal conditions, whereas powellite ($CaMoO_4$), which contains oxidized Mo^{6+}, requires a higher oxidation state for its stability (Fig. 2.1; Hsu 1977).

Thus, the composition of the minerals belonging to the scheelite-powellite series will be directly influenced by the physicochemical environment of formation (Fig. 2.1, 2.2; Hsu and Galli 1973,

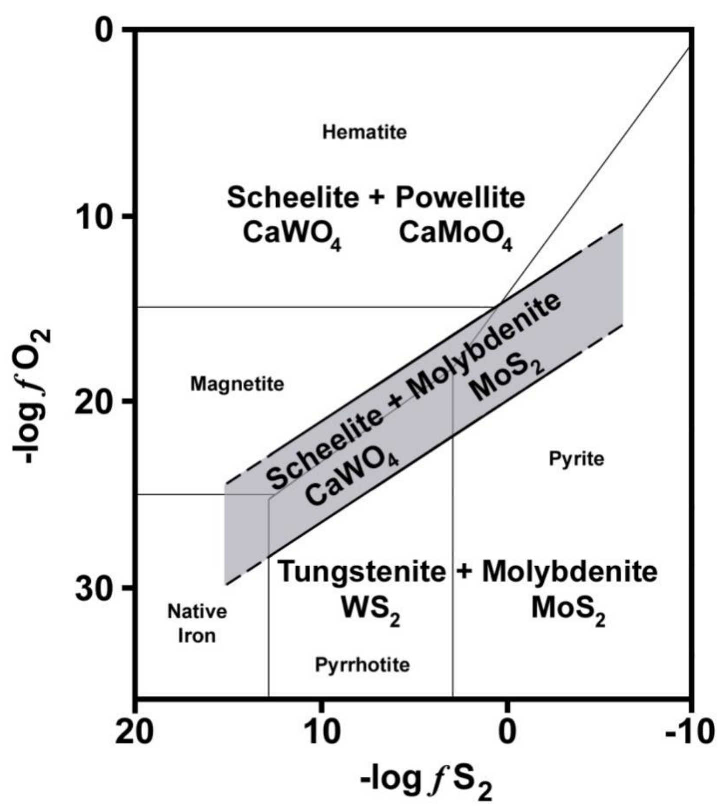

Figure 2.1: The -log fO_2 – -log fS_2 diagram indicating the stability field of coexisting scheelite and molybdenite at 577°C and 1000 bars fluid pressure (Modified from Hsu 1977).

Hsu 1977, Tyson *et al.* 1988). The relationship between the luminescent colour of scheelite under UV light and Mo concentration has been well documented (*e.g.*, Hsu and Galli 1973, Shoji and Sasaki 1978, Hsu 1981). In particular, a change in the emission colour from whitish-blue to yellow when the $CaMoO_4$ mole fraction exceeds 2 % (≈ 6700 ppm; Hsu and Galli 1973, Shoji and Sasaki 1978, Hsu 1981). Additional chemical substitutions ([8]-site) in scheelite include minor amounts of Sr^{2+} (≤5600 ppm), Pb^{2+} (≤200 ppm), and ΣREE+Y. While most scheelite contains <2000 ppm ΣREE+Y, enrichments up to 2.0 wt. % REE_2O_3 have been noted (Semenov 1963, Cottrant 1981, Dostal *et al.* 2009). In general, scheelite preferentially incorporates LREE (La-Nd) over HREE (Ho-Lu) due to ionic radii considerations (Cottrant 1981, Raimbault *et al.* 1993, Ghaderi *et al.* 1999). The substitution of $REE^{3+} \leftrightarrow Ca^{2+}$ is not isovalent, so requires a charge balance mechanism, a number of possibilities are discussed below.

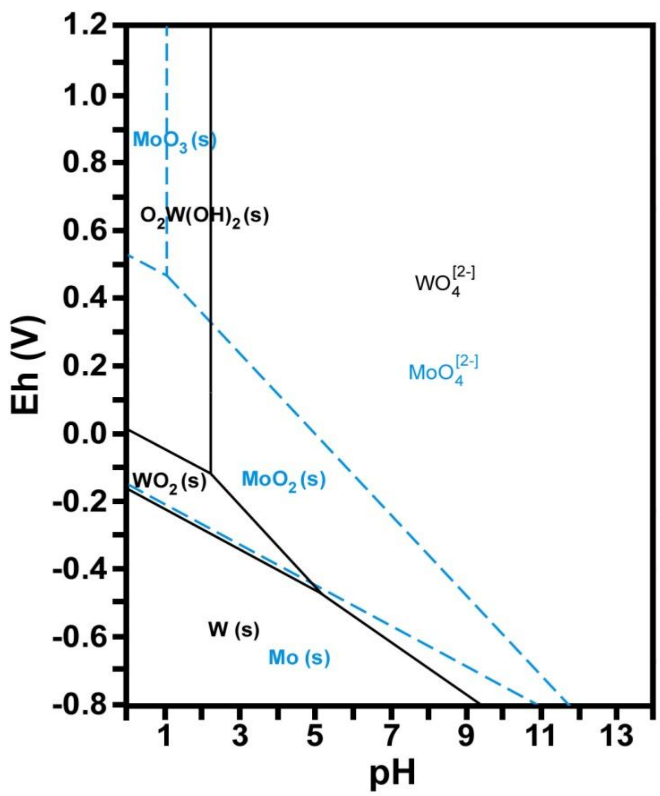

Figure 2.2: The Eh-pH diagrams of the W-O-H system (solid lines) and Mo-O-H system (dashed lines) at 25°C and 1 bar. Note that the solid phases are in bold (Modified from Takeno 2005).

2.2.2. Cathodoluminescence

Cathodoluminescence (CL) results from the emission of photons in the ultraviolet, visible and infrared range of the electromagnetic spectrum from a material exposed to high-energy electron bombardment [for reviews see Marfunin (1979, 1995) and Yacobi and Holt (1990)]. In the visible range, luminescence occurs in a variety of colours (blue, violet, red, brown, green), depending on the material being studied. In general, the CL response of a mineral can be attributed to the following: (1) intrinsic defects, which include the development of site vacancies, structural imperfections (*i.e.*, poor ordering in the crystal structure, radiation or shock damage), and impurities (*i.e.*, non-activators that distort the lattice); and (2) extrinsic defects, which results from trace elements being incorporated in the structure, which in turn generate luminescent centres (Götze *et al.* 2001, Götze 2002,). There are multiple extrinsic interactions that influence the CL response of a mineral, such as activators (promote a CL response; *e.g.*, Mn^{2+}, Cr^{3+}, Fe^{3+}, Ti^{4+}, REEs) and quenchers (inhibit or eliminate a CL response; *e.g.*, Fe^{2+}, Co^{2+}, Ni^{2+}). The CL response of a mineral is a complex balance between the absolute and relative concentrations of activators and quenchers, both of which impact on the overall intensity and colour of a CL emission (*e.g.*, Marfunin 1979, Marshall 1988, Yacobi and Holt 1990, Götze *et al.* 2001, Boggs *et al.* 2002, Rusk *et al.* 2008, Rusk 2012, Siebel *et al.* 2012, Wendler *et al.* 2012, Vonlanthen *et al.* 2012).

Scheelite can produce an intense CL response (*e.g.*, Blanc *et al.* 2000, Brugger *et al* 2000*b*, MacRae *et al.* 2009) that may result from one of several different luminescence mechanisms. The first and most important is the self-activated emission band (also referred to as a self-luminescence band, SB) that produces a broad spectral peak, which is intrinsic to the mineral, this being attributed to the WO_4^{2-} tetrahedral complex. Complexes such as this involve transitions from charge-transfer bands and molecular orbital states not localized on the cation, in contrast to transition metals which absorb energy and re-emit it *via* *d-d* block transitions (*e.g.*, Grasser *et al.* 1988, Marfunin 1995, Uspensky *et al.* 1998). Secondly, the spectral data for scheelite show a number of peaks associated with *f*-block electrons, these being attributed to REE. In general, use of CL spectra to measure element concentrations is not recommended owing to the complexities associated with activators (*e.g.*, Y^{3+}) and quenchers (*e.g.*, Fe^{2+}; Kempe and Götze 2002). A third mechanism involves emission-reabsorption (termed cascade luminescence), which occurs when the emission from a sensitizer is partly or wholly absorbed and then emitted by the activator (*e.g.*, emission from Dy^{3+} ions in scheelite that are excited by emissions arising from the WO_4^{2-}complex). Finally, concentration quenching (or self-quenching) is a non-radiative (*i.e.*, without absorption or emission of photons) type of luminescence that is produced as a result of the energy transfer between nearby ions of the same type.

2.3. Sampling and methodology

Scheelite samples representing a variety of deposit settings were selected to provide a comprehensive suite of the geological and *P-T-X* conditions under which the mineral develops. From these, concentrates of five grains from orogenic Au, skarn, porphyry-related, and greisen-type environments, were selected for detailed analyses. Relevant information relating to the samples in this study, including geological setting, nature of the host rock, mineral assemblages, and general CL responses, is summarized in Table 2.1.

The scheelite grains examined are 1-12 mm across, sub- to euhedral and colourless, dark-pink, light-orange or light-grey (Table 2.2). The grains selected were inclusion-free, with the exception of those from the Sigma Au deposit that contained minor amounts of native Au. Grain mounts were prepared by mounting in epoxy, grinding the mounts to expose the scheelite grains, followed by final polishing with a 0.5 μm diamond powder paste.

CL imaging was conducted using a JEOL6400 SEM equipped with a GatanChromaCL^{TM} mirror-type CL detector and a linear array photomultiplier tube (PMT) with 16 separate photocathodes. The signal from each of these is fed to the detector electronics, where any number of the detector elements can be combined into one of the four pulse-counting amplifier channels. The CL detector is more efficient in the blue than the red part of the spectrum, although the other components of the ChromaCL^{TM} optics have been designed to allow efficient light collection and transmission between 300 and 800 nm. The ChromaCL^{TM} software applies an "auto-survey" operation during image recording; this calculates the intensity according to a 12-matrix look up table (*i.e.*, raw input data are transformed into sensible display values). The "auto-survey" presents a result that most closely represents the true colour; this is because it takes account of both the intensity of the raw signals as well as the biasing applied using the matrix table. As the system was not calibrated using wavelength-dependent detector-efficiency corrections, it cannot quantify the CL spectra obtained, thus only the spatial distribution of the luminescence colours were recorded. To confirm that correct colour assignments were made by the ChromaCL^{TM} software, direct visual observations were made using an optical (cold-cathode) CL with a luminoscope and Model ELM-2A specimen chamber. The CL response of scheelite can be highly variable, in some cases, so intense as to cause detector oversaturation. As such, the optimal conditions under which CL imaging was conducted were arrived at through a trial-and-error manner. These include a 5 kV accelerating voltage and beam current of 0.010 nA with a working distance of 16 mm all of which combined to produce the sharpest images with the greatest detail. Of note during alternative settings, increases in the operating current

Table 2.1: A summary of relevant geologic information for the scheelite samples used in this study, as compiled from the literature and the work reported in this paper.

Deposit[1]	Country	Type of Mineralization	Commodity[2]	Age of Mineralization[3]	Host Rock(s)	Intrusion Type	CL Response[4]	Principal Mineral Assemblages[5]	References
Ortiz Mine (Cunningham Hill) *(D)*	New Mexico, USA	Breccia?	Au-Ag (W-Cu)	OLIGO (≈ 28 Ma)	Bx (Qzt, Ss, Shl)	Mz / Mzd	Homogenous blue.	Qtz-Py-Mgt-Cal-Sd-Cp-Au-Scl	Maynard (1995)
Castañeda de Llamuco Mine *(D)*	Chile	Breccia?	Cu (W)	CRET*	And	Gr	Homogenous blue.*	Qtz-Ms-Scl-Apy-Tur-Py-Cal (Cp-Gn-Wf)	McAllister and Ruiz F. (1948); Sillitoe (1973)
Silverton (Sunnyside Mine?) *(D)*	Colorado, USA	Polymetallic vein	Zn-Pb-Cu (Ag-Au)	MIO (13 – 16.6 Ma)	Qtz-latite, Seds, Bx	Qtz-Mz	Homogenous blue.	Qtz-Sph-Gn-Py-Rds-Cp-Td-Fl-Cal	Rosenzweig (1957); Casadevall and Ohmoto (1977); Eberl *et al.* (1987)
Huya *(D)*	China	Polymetallic vein	W-Sn (Be)	EJUR (182 ± 9.2 Ma)	Phy, Mrb	Qtz-Mz / Mzd	Homogenous blue. Minor 1 – 5 µm zonations are present.	Qtz-Ms-Tur-Scl-Brl-Cst-Fl-Cal	Cao *et al.* (2002); Liu *et al.* (2007)
A.M. Berges W-Prospect *(O)*	Mexico	Polymetallic vein?	Ag (Pb-Zn-Au)	MIO*	Ss (Shl, Sltst, Carb)	Gr / Grd	Two types of textures present (1) homogenous blue and (2) blue with blebby white/blue overgrowths.	Qtz-Cal-Py-Sp-Gn-Cp	Lopez *et al.* (2012)
Kovárna Mine (Obří dul, Riesengrund) *(D)*	Czechoslovakia	Polymetallic vein?	Fe-As-Cu (W)	CARB* (304 – 329 Ma)	Schist, Qzt, Ls	Bt-Grd	Homogenous blue.	Qtz-Cal-Po-Fl-Cp-Asp-Mgt (Scl-Py-Gn-Sp-Mlb-Cst-Rt)	Štemprok (1986); Žák, J. and Klomínský (2007); Žák, J. *et al.* (2008)
Barewood *(D)*	New Zealand	Turbidite-hosted	Au (W)	ECRET (125 Ma)	MetaGwke	n.d.	Homogenous blue.	Qtz-Scl-Apy (Au-Py-Cp-Sp-Gn)	MacKenzie and Craw (1993); Pitcairn *et al.* (2006)
Moose River *(D)*	NS, Canada	Turbidite-hosted	Au (W-Pt)	EDEV (408 – 380 Ma)	Qzt, Arg, slate	Gr-Grd	Homogenous blue.*	Qtz-Ank-Cal-Dol-Chl-Bt-Ms-Scl (Apy-Po-Cp-Gn-Mlb-Au)	Mulligan (1984); Hudgins (1996); Sangster and Smith (2007)
Jardine *(D)*	Montana, USA	Turbidite-hosted?	Au (As-W)	ARCH*	Metaturbidite (metapelite, BIF)	Qtz-Mz	Homogenous blue.	Qtz-Hbl-Grt-Bt-Apy-Po-Cp (Gn-Au-Scl)	Fraser *et al.* (1969); Smith (1996)
Delnite *(D)*	ON, Canada	Greenstone-hosted	Au-Ag	ARCH	Komatiites, tholeiitic basalts	n.d.	Homogenous blue.*	Qtz-Cal-Apy-Py-Tur (Au-Scl)	Taylor (1948); Ferguson *et al.* (1971)
Morro Velho *(D)*	Brazil	Greenstone-hosted	Au	LARCH (2672 ± 14 Ma)	Fe-Dol (slate, metavolcanics)	Tonalite-Grd	Homogenous blue.*	Qtz-Dol-Sd-Cal-Ms-Chl-Ab (Ep-Rt-Ap-Ilm-Mgt-Py-Tur-Scl)	Bernasconi (1985); Lobato *et al.* (2007); Vial *et al.* (2007)
Sigma Au Mine*(D)*	QC, Canada	Greenstone-hosted	Au	ARCH	Calc-alkalic tuffs, tholeiilitc basalts	D	Homogenous blue.*	Qtz-Tur-Cal-Ms-Chl (Py-Scl-Cp-Au)	Robert and Brown (1986a,b); Olivo *et al.* (2006)
Mackenzie Mine *(D)*	ON, Canada	Greenstone-hosted	Au-Ag	LARCH* (2720 ± 3 Ma)	Mylonite-D	D / Qtz-D	Homogenous blue.*	Qtz-Cal-Ms-Tur-Py-Apy-Ank (Au-Scl-Cp-Gn-Sp)	Horwood (1948b); Ferguson *et al.* (1971); Dubé (2004)
Little Long Lac *(D)*	ON, Canada	Greenstone-hosted?	Au-Ag (W)	ARCH*	Felds-Qzt	D	Homogenous blue.	Qtz-Apy-Cp-Tur (Gn-Au-Scl-Po)	Bruce and Samuel (1937); Horwood (1948a); Ferguson *et al.* (1971)
Hollinger *(D)*	ON, Canada	Greenstone-hosted?	Au (W)	LARCH* (2617 ± 15 Ma)	Tholeiitic basalts, Carb	Grd	Homogenous blue.*	Qtz-Scl-Ank-Py-Ab-Tur (Au-Ap-Cp-Sp-Gn-Po)	Allen and Folinsbee (1944); Jones (1948); Wood (1991)
Crane *(O)*	ON, Canada	Greenstone-hosted?	W (Au-Mo)	LARCH (2680 Ma)	Cgl-schist, Bt-Chl-schist	Grd	Homogenous blue.	Qtz-Scl-Mlb-Py (Ms-Pl-Cal-Au)	McCartney (1943); Nickel (1952)
Rocher Déboulé *(D)*	B.C., Canada	Greisen	Cu-Ag (Au-W)	LCRET*	D, Qzt, Mdst, Sltst	Grd / D	Dark blue with yellowing along fractures	Hlb-Qtz (Pl-Ap-Mgt-Scl-Tur-Fbr-Mlb)	Sutherland Brown (1960); Burgonyne and Kikauka (2007)
Carrock Fell *(D)*	United Kingdom	Greisen	W (Mo)	MDEV (386 ± 6 Ma)	Gnt, gabbro, slate (Hfls?)	Gr	Homogenous blue.*	Qtz-Ms-Ap-Wf-Scl (Py-Apy-Po-Fl-Dol-Cal)	Appleton and Wadge (1976); Shepherd and Waters (1984); Ball *et al.* (1985)
Zinnwald – Cínovec *(D)*	Germany–Czech Republic	Greisen	Sn-W-Li	ECARB – DEV* (330 – 395 Ma)	Greisens, Gnt	Gr	Complex zonation varying from 1 – 100 µm.	Qtz-Cst-Znw-Wf-Scl-Sd-Cal-Toz-Ms-Fl	Durisoval *et al.* (1979); Štemprok (1986); Webster *et al.* (2004)

Sisson W-Mo Deposit *(D)*	NB, Canada	Porphyry-related	W-Cu-Mo	LDEV* (379 Ma)	Meta-gabbro / volcanics / Seds	Gr	Homogenous blue.	Qtz-Scl-Mlb-Hbl-Bt-Mgt-Ab-Po (Wf-Py-Cp)	Nast and William-Jones (1991); Bustard *et al.* (2013)
Kalzas (Flo Property) *(O)*	YT, Canada	Porphyry-related	W (Sn)	LCRET* (90 – 95 Ma)	Clastic metaSeds	Gr	Homogenous blue.	Qtz-Tur-Wf-Py-Ms-Cst (Or-Ap-Mlb-Scl-Apy)	Lynch (1989); Carlson (2002)
Dublin Gulch (Eagle Zone?) *(D)*	YT, Canada	Porphyry-related	Au (W)	LCRET* (92.8 ± 0.5 Ma)	Qzt, Phy, schist (Carb)	Bt-Grd	Irregular CL present. The variation between bright and dark blue is delineated by grain fractures.	Qtz-Kfs-Ab-Cal-Ms-Chl-Scl-Po-Apy-Py	Sinclair (1986); Brown *et al.* (2002); Maloof *et al.* (2001)
Dae Hwa (Taewha) *(D)*	South Korea	Porphyry-related	W-Mo	LCRET (82 ± 2 Ma)	Bt-Gr-gneiss	Gr	Homogenous blue. Darkening of CL response along fractures.	Qtz-Ms-Brl-Mlb-Cst-Wf-Scl-Fl (Py-Po-Cp)	Bancroft (1979); So *et al.* (1983); Sheldon *et al.* (1987)
NUG-4 Claim (Quick and Easy) *(O)*	NWT, Canada	Porphyry-related?	Au-W (Zn-Ni-Bi)	LDEV	Bt-Mz, Sltst, Arn, chert, Ls, Hfls	Bt-Mz	Fine (2 – 5 µm) zonations present.*	Qtz-Scl-Cal-Wf-Dol (Po-Py-Apy)	Gordey and Anderson (1993); Downie (2004)
Yongwol (Yeongwol-gun) *(D)*	South Korea	Porphyry-related?	W-Mo	LCRET*	Shl, Ls	Mz	Irregular zones of bright and dark blue CL.	Qtz-Dol-Scl-Mlb-Py-Wf-Di-Grt-Hbl-Fl-Ap	Laznicka (2006)
Tungstar *(D)*	California, USA	Skarn – Endo	W (Si)	CRET*	Ls, Hfls, Qtz-D	Qtz-D	Homogenous blue.	Grt-Ep-Qtz-Py-Ap-Ttn-Scl	Lemmon (1941); Bateman (1953)
Emerald *(D)*	BC, Canada	Skarn – Exo	W-Mo (Au-Pb-Zn)	CRET	Ls, Arg (Shl?)	Gr	Dark-green/yellow cores with blue rims.	Px-Grt-Amp (Bt-Ep-Pl-Ves-Scl-Pwl-Wf-Mlb-Po-Py-Cp)	Ball (1954); Mulligan (1984); Cathro and Lefebure (2000)
Traversella *(D)*	Italy	Skarn – Exo	Cu-Fe (W)	OLIGO* (30 ± 5 Ma)	Gneiss, eclogitic micaschists, Dol	Mz-D	Homogenous blue.*	Cal-Dol-Scl-Mgt-Cp-Fo-Px-Chl-Wo-Di	Dubru *et al.* (1988); Vander Auwera and Andre (1991); Vander Auwera and Verkaeren (1993)
San Alberto *(D)*	Mexico	Skarn – Exo	W (Cu)	PALEO (56.4 Ma)	Ls	Qtz-Mzd	Irregular, diffuse zoning present between bright and dark blue.	Qtz-Cal-Grt-Amp-Scl-Ep	Anstett *et al.* (1985); Mead *et al.* (1988)
Kumbel (Kara-Urkurt) *(D)*	Kyrgyzstan	Skarn – Exo	W-Cu-Mo (Au)	CARB* (≈ 310 – 312 Ma)	Ls, Ss	Mz / Mzd	Coarse zonation (30 – 300 µm).	Qtz-Cal-Amp-Px-Cal-Grt-Scl-Cp-Ves-Hem-Mgt-Py-Mlb-Brl-Ap	Rabchevsky (1988); Soloviev (1994, 2015)
Sangdong *(D)*	South Korea	Skarn – Exo	W-Mo (Bi-Au)	LCRET (84 ± 3 Ma)	Ls (Hfls, Ss, Shl)	Gr	Homogenous blue.	Qtz-Bt-Ms-Scl (Hbl-Grt-Di-Wf-Mlb-Fl)	Farrar *et al.* (1978); Laznicka (2006)
Cantung *(D)*	NWT, Canada	Skarn – Exo	W	LCRET (91.4 Ma)	Ls (Arg, Qzt, Hfls, Mrb)	Bt-Gr	Homogenous blue with minor weak zoning *	Scl-Po-Cp-Di-Px-Qtz-Amp (Cal-Tur-Ap)	Mathieson and Clark (1984); Laznicka (2006)
Flat River (M.B. Prospect) *(O)*	NWT, Canada	Skarn – Exo?	W	LCRET* (90 – 92 Ma)	Ls, Arg	Qtz-Mz	Moderate zoning (50 – 100 µm) containing fine zonations (5 – 10 µm).*	Px-Grt-Ves-Scl-Chl-Qtz-Cal (Wo-Cp)	Blusson (1968); Mulligan (1984); Burt (1986)
Tulare *(O)*	California, USA	Skarn – Exo?	W	LCRET*	Dol, Ls	Grd	Homogenous blue.	Grt-Qtz-Scl (Cal-Py-Mlb-Pwl)	Krauskopf (1953)
Guadalupana *(O)*	Sonora, Mexico	Skarn – Exo?	Ag-Au	EO?	Rhy, And, Tuff, Shl	n.d.	Homogenous blue.	Qtz-Ves-Tur-Ep-Scl-Ap-Pwl-Ttn	Trask and Cabo (1948); Panczner (1987); Clark and Fitch (2009)
Hermosillo *(D)*	Mexico	Skarn – Exo?	W	PALEO*	Ls, Shl	Grd	Weak zoning present?*	Qtz-Cal-Grt-Ep-Scl	Mead *et al.* (1988)
Darwin *(D)*	California, USA	Skarn?	W (Pb-Zn-Ag)	MJUR* (174 Ma)	Ls, Ss, Hfls	n.d.	Single 10 µm zonation present.	Ves-Grt-Wo-Di-Ep-Scl-Gn-Sp-Py-Cp-Cal	Hall and Mackevett (1962); Newberry *et al.* (1991)
Sanford *(O)*	Maine, USA	Skarn	Mo-W	CARB* (322 ± 12 Ma)	Gfls (Mrb)	Bt-Gr	Homogenous blue.*	Ves-Fl-Sp-Cal-Di-Grt-Qtz (Mlb-Scl-Pwl-Ttn)	Leavitt and Leavitt (1993)
Britannia Mine *(D)*	BC, Canada	VMS	Cu-Zn-Pb (Ag-Cd-Au)	CRET*	Chl-Ms-schist, slate	Qtz-D / Qtz-Mzd	Coarse zonation (10 – 300 µm).*	Qtz-Py-Ms-Chl-Cp-Sph (Anh-Gn-Tn-Td)	Schofield (1926); Irvine (1948); Payne *et al.* (1980)

[1] Alternative names in ( ); Denotes deposit *(D)* and occurrence *(O)*.
[2] Metals and minerals are generally listed in approximate decreasing order of abundance (some may be sub-equal in abundance); metals and minerals in parentheses are minor; paragenetic sequences have been combined for simplicity.
[3] In some instances the age of mineralization is related to the age of associated magmatism*.
[4] CL responses collected by this study; In some instances, a bright blue/white CL response is observed along grains boundaries and fractures (*).
[5] Abbreviations are those recommended by Kretz (1983) and Spear (1993); In cases of districts, not all minerals may be present in a given deposit; n.d. = no data.

frequently resulted in the oversaturation of the CL emission. The CL images produced in this study were captured at 350x magnification, which gave a sufficiently high spatial resolution such that the presence of fine-scale (<10 μm) zonation patterns could be observed. All images were collected using the same protocol (*i.e.*, the same scan rate and pixel-dwell time) in order minimize the variability in CL intensity. Since many of the grains analyzed in this study were relatively large (>1 mm), several CL images were collected and stitched together using Adobe Photoshop, with no subsequent colour enhancement or modifications.

Table 2.2: A summary of the physical properties of the scheelite samples used in this study.

Deposit	Deposit Type	Colour	Size (Individual crystals)	Crystal Habit	CL response	Fluorescence
Sigma Au Mine	Greenstone-hosted	Salmon/Grey	≤ 12 mm	Subhedral	Homogenous blue.	White/Pale Blue
Britannia	VMS	Pink/Beige	≤ 3 mm	Euhedral	Coarse zonation (10 – 300 μm).	Weak beige
Kumbel	Skarn – Exo	Beige/White	≤ 2 mm	Euhedral	Coarse zonation (30 – 300 μm).	Pale green/yellow
Zinnwald – Cínovec	Greisen	Grey	≤ 2mm	Subhedral to euhedral	Complex oscillatory zonation (1 – 100 μm.)	Yellow/pale green

Semi-quantitative SEM-EDS analyses for major and minor elements were obtained along with the collection of qualitative elemental X-ray maps. The X-ray maps were also collected on the JEOL6400 SEM instrument, using a solid-state detector with an active area of 80 mm, collecting times of 393 s per frame and ten frames per image. The analytical conditions for elemental analysis were accelerating voltage of 20 kV and beam current of ~ 1 nA.

Sample LA-ICP-MS ablation was carried out at Laurentian University using a RESOlution M-50 193 nm excimer laser equipped with a two-volume Laurin Technic sample cell. The ablated material was analyzed using a Thermo X SERIES II quadrapole ICP-MS. A small (6 ml/min) stream of N_2 gas was added to increase sensitivity. Spot analyses for trace-elements used a beam of ~ 47 μm with a 30 s washout between spots. Laser-ablation maps were collected using a ~ 19 μm spot size, a scan velocity of 10 μm/s, and a laser pulse repetition rate of 10 Hz. These were generated by a lined-raster map (perpendicular to zoning in CL if applicable) with a 30 s washout between lines (laser off). Acquisition times for most masses were set to 10 ms; however the major elements in scheelite (Ca, W) were measured for 5 ms and trace elements (Y + REEs) for 15 ms. Data were processed using Iolite (Paton *et al.* 2011) using Ca^{44} as the internal standard. In general, the Ca content of scheelite varies by no more than 5 % of the expected ideal value. This is supported by the study of the Baizhangyan and Jitoushan W-Mo deposits by Song *et al.* (2014) who demonstrated that the variation in Ca content from 13.62 to 14.10 wt.% (stoichiometric Ca = 13.92%). The variation in Ca is within ± 2.2 wt. % and on this basis; no correction was applied for variations in the Ca internal standard. The standard glasses NIST 612 and BHOV 2G (Pearce *et al.* 1997) was used as primary calibration standards. Each of these was analyzed before and after every line or a series of spots to account for the instrument drift.

2.4. Results

All of the 121 scheelite grains from the 39 localities examined in this study (Table 2.1) exhibit a strong CL response, varying in colour from dark to light blue, but with a wide variation in zonation patterns, ranging from being absent to those showing extremely complex patterns. Where zonation patterns are present, the widths of individual zones range from < 1 µm to > 300 µm with perceived colours ranging from pale to dark blue. Detailed analyses were undertaken on five grains representing the spectrum of observations made with respect to zonation, these varying from slight or regular to intricate and complex. These are discussed below, starting with the grains showing the simplest type of zonation and progressing towards more complex patterns.

To further investigate the chemical nature behind the observed zonation in scheelite, quantitative elemental maps were generated based on LA-ICP-MS analyses (Fig. 2.3-5, 2.7-8). Further, to facilitate comparison between results, the statistical measures (mean, median, minimum, and maximum) for elements of interest obtained by LA-ICP-MS for each grain are presented in Table 2.3. Of the 35 elements that were analyzed for, those with the highest concentrations include: As (≤2320 ppm), Sr (≤696 ppm), Mo (≤67 900 ppm), and the REEs (≤1077 ppm for ΣREE+Y). Generalities based on the LA-ICP-MS analyses indicate: (1) concentrations of the large-ion lithophile elements (LILE: Li, Na, K and Rb), most being below the detection limit (bdl); (2) for the alkaline-earth elements, Sr ranges from 70 to 696 ppm, and Ba is bdl; (3) the semi-metals, As ranges from bdl to 2320 ppm and B from bdl to 145ppm; (4) the transition metals (Fe, Ti, V, Cr, Ni, and Zn), most of being below the bdl, the exception being Mo which ranges from 15 to 67900 ppm; and (5) ΣREE+Y range from bdl to 1077 ppm.

2.4.1. Sigma Au Deposit, Val-d'Or, Québec, Canada

Scheelite from the Sigma Au deposit (Val-d’Or, Québec, Canada; Robert and Brown 1986a, b, Olivo *et al.* 2006) has a homogenous blue CL response that is consistent with the CL response observed in scheelite from other orogenic Au deposits examined in this study (*e.g.*, Morro Velho, Hollinger mine, Mackenzie mine). Slight intensity variations within a single frame are observed (*e.g.*, the upper left corner of each frame appears darker than the corresponding lower right corner), but these are considered to be artefacts arising from the electron-beam-detector geometry.

Scheelite from this locality exhibits the lowest average trace element content of those examined in this study Mo = 16 ± 0.5 ppm, As = 9 ± 0.5 ppm, Sr = 279 ± 3 ppm, and is relatively enriched in ΣREE+Y (990 ± 3 ppm). Some minor spatial variability in the concentrations of Mo (Fig. 2.3d), La and Gd (Fig. 2.3f, g) are noted in the LA-ICP-MS maps. These variations are minor and do not appear to correlate with the observed CL response.

2.4.2. Britannia Mine, British Columbia, Canada

The Britannia mine (British Columbia, Canada; Schofield 1926, Irvine 1948, Payne *et al.* 1980) is a structurally controlled, Noranda-style massive sulphide deposit. Scheelite from here displays a complex CL response in that it exhibits primary growth areas that are oscillatory zoned, but with individual zones varying in width (Fig. 2.4a). Examination of the CL response of this grain (Fig. 2.4a) reveals the following features: (1) contacts between zones that are regular (*i.e.*, constant width), sharp and distinct with individual zones ranging in width from 10 to 300 μm; (2) both irregular and diffuse zones are present; (3) narrow (2 to 15 μm), late-stage, cross-cutting zones with bright CL responses are present; and (4) a late-stage overgrowth or fringe mantling part of the grain is evident.

Scheelite from the Britannia mine exhibits variable concentrations of Mo, with an average of 8215 ± 1005 ppm and ranging from 3150 ± 260 to 25 900 ± 3100 ppm. Furthermore, the LA-ICP-MS map for Mo (Fig. 2.4d) reveals variations throughout the grain, with pronounced chemical zones and dissolution patches. Arsenic averages 94 ± 15 ppm with a range from bdl to 367 ± 74 ppm, and Sr averages 93.9 ± 11.0 ppm, with the highest concentrations in the cross-cutting features (up to 229.0 ± 17.0 ppm). The ΣREE+Y concentrations can vary significantly within each zone and range from bdl to 598 ± 15 ppm. The largest variations in ΣREE+Y occur in the primary zones, with the late-stage overgrowth showing a significant depletion in these elements (Fig. 2.4f, g).

Table 2.3: A summary of the results of LA-ICP-MS analyses (ppm) of scheelite for the four deposits examined in this study.

Sample #	LOD[1]	CMN 86063 Sigma Au Mine (n = 4)				CMN 50171 Britannia (n = 24)			
Element		*Min*	*Max*	*Median*	*Mean*[2]	*Min*	*Max*	*Median*	*Mean*[2]
Li	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	24 (49.0)	6	8 (13.0)
B	15	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	54 (6.4)	45	44 (7.8)
Na	1554	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
K	25	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	26 (21.0)	26	26 (21.0)
Ti	2	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	19 (19.0)	6	8 (13.6)
V	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	9 (41.0)	9	9 (41.0)
Mn	0.9	6.7 (0.4)	8.8 (0.4)	7.1	7.4 (0.4)	≤ LOD	15.0 (11.0)	6.0	7.0 (10.3)
Fe	2	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	140 (220.0)	40	49 (77.5)
Co	0.8	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	1.5 (1.0)	1.1	1.1 (1.0)
Ni	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	10 (10.0)	6	6 (11.9)
Cu	2	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	6 (7.6)	3	3 (3.5)
Zn	2	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	6 (20.0)	3	3 (5.6)
As	1	6 (0.3)	11 (0.7)	9	9 (0.5)	≤ LOD	367 (74.0)	58	94 (15.5)
Rb	0.6	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	1.0 (4.6)	1.0	1.0 (4.6)
Sr	0.5	260.0 (3.1)	289.9 (3.0)	283.0	279.0 (3.0)	69.8 (6.6)	229.0 (17.0)	85.6	93.9 (11.0)
Y	0.5	360.3 (3.1)	409.7 (4.5)	402.0	393.5 (3.8)	≤ LOD	7.5 (5.1)	2.0	2.3 (0.9)
Mo	1	15 (0.5)	17 (0.5)	15	16 (0.5)	3150 (260.0)	25900 (3100.0)	5760	8215 (1005.4)
Ag	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0.4	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
Ba	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	2 (2.5)	2	2 (2.5)
La	0.2	4.9 (0.10)	9.3 (0.15)	7.7	7.4 (0.13)	≤ LOD	118.0 (22.00)	33.6	36.0 (4.05)
Ce	1.3	36.3 (0.45)	58.8 (0.68)	52.7	50.1 (0.60)	1.3 (1.30)	319.0 (71.00)	69.7	95.6 (13.11)
Pr	0.1	10.7 (0.13)	16.0 (0.23)	14.4	13.9 (0.19)	0.2 (0.15)	37.7 (5.50)	9.5	11.9 (1.77)
Nd	0.5	82.8 (1.20)	125.8 (1.60)	112.0	108.1 (1.38)	1.5 (0.83)	109.0 (21.00)	29.1	36.1 (5.73)
Sm	0.5	44.6 (0.77)	69.4 (1.20)	62.2	59.6 (0.95)	≤ LOD	10.4 (7.00)	1.5	2.3 (0.95)
Eu	0.09	54.18 (0.65)	64.51 (0.74)	55.60	57.47 (0.69)	≤ LOD	1.10 (1.10)	0.19	0.28 (0.16)
Gd	0.2	67.3 (0.91)	112.2 (1.80)	102.1	95.9 (1.30)	≤ LOD	7.8 (3.00)	0.9	1.2 (0.52)
Tb	0.2	12.3 (0.15)	18.5 (0.30)	17.6	16.5 (0.22)	≤ LOD	0.6 (0.48)	0.2	0.3 (0.22)
Dy	0.4	82.8 (0.89)	116.3 (1.30)	111.5	105.5 (1.32)	≤ LOD	2.8 (2.90)	0.7	0.9 (0.61)
Ho	0.2	14.6 (0.15)	19.8 (0.27)	19.2	18.2 (0.23)	≤ LOD	≤ LOD	n.d.	n.d.
Er	0.3	35.1 (0.49)	43.6 (0.61)	43.0	41.2 (0.53)	≤ LOD	≤ LOD	n.d.	n.d.
Tm	0.3	4.0 (0.08)	4.5 (0.08)	4.3	4.3 (0.08)	≤ LOD	≤ LOD	n.d.	n.d.
Yb	0.3	16.6 (0.35)	18.1 (0.36)	17.0	17.2 (0.33)	≤ LOD	0.6 (1.20)	0.6	0.6 (1.20)
Lu	0.5	1.4 (0.04)	1.5 (0.04)	1.4	1.4 (0.04)	≤ LOD	≤ LOD	n.d.	n.d.
ΣREE+Y		838.0 (2.2)	1077.0 (3.3)	1022.9	990.2 (2.8)	4.0 (2.7)	593.0 (77.5)	138.6	183.3 (15.5)

[1] The limit of detection (LOD) was calculated from repeated measurements of NIST 612;
[2] The means were calculated using data above LOD;
n.d. not determined.

(continued on next page)

Table 2.3: (Continued)

Sample #	LOD[1]	CMN 53448 Kumbel (*n* = 33)				CMN 82045 Zinnwald–Cínovec (*n* = 126)			
Element		*Min*	*Max*	*Median*	*Mean*[2]	*Min*	*Max*	*Median*	*Mean*[2]
Li	1	≤ LOD	9 (6.7)	6	6 (6.3)	≤ LOD	25 (27.0)	8	8 (10.3)
B	15	≤ LOD	143 (64.0)	96	100 (39.3)	≤ LOD	42 (7.3)	28	30 (3.3)
Na	1554	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
K	25	≤ LOD	26 (27.0)	26	26 (27.0)	≤ LOD	100 (130.0)	43	48 (133.1)
Ti	2	≤ LOD	12 (8.1)	4	6 (9.5)	≤ LOD	43 (25.0)	9	11 (19.1)
V	1	≤ LOD	2 (1.3)	2	2 (1.3)	≤ LOD	4 (1.3)	2	2 (2.2)
Cr	1	≤ LOD	3 (16.0)	2	2 (12.3)	≤ LOD	28 (46.0)	6	8 (24.5)
Mn	0.9	≤ LOD	5.8 (8.2)	4.6	4.6 (7.9)	≤ LOD	20.0 (17.0)	5.0	6.7 (12.2)
Fe	2	≤ LOD	39 (81.0)	29	29 (70.0)	≤ LOD	54 (34.0)	14	18 (27.7)
Co	0.8	≤ LOD	1.4 (0.6)	1.2	1.2 (0.5)	≤ LOD	1.3 (0.4)	1.0	1.0 (1.1)
Ni	1	≤ LOD	8 (9.6)	4	5 (7.5)	≤ LOD	17 (34.0)	6	7 (11.8)
Cu	2	≤ LOD	4 (3.1)	2	3 (3.2)	≤ LOD	7 (4.2)	4	4 (5.2)
Zn	2	≤ LOD	3 (3.2)	2	2 (2.5)	≤ LOD	7 (11.0)	3	3 (4.3)
As	1	≤ LOD	510 (31.0)	164	193 (22.5)	178 (22.0)	2320 (700.0)	623	747 (142.7)
Rb	0.6	≤ LOD	0.7 (0.4)	0.7	0.7 (0.4)	≤ LOD	2.5 (3.4)	0.9	1.0 (1.0)
Sr	0.5	72.9 (6.5)	225.0 (21.0)	88.3	96.2 (10.3)	86.0 (13.0)	696.0 (54.0)	250.5	296.6 (42.8)
Y	0.5	≤ LOD	5.0 (0.9)	1.2	1.8 (0.5)	≤ LOD	133.9 (8.9)	12.1	18.1 (4.6)
Mo	1	3050 (230.0)	14300 (2000.0)	10850	9406 (1073.2)	520 (220.0)	67900 (8600.0)	10050	14601 (2566.6)
Ag	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	0.7 (0.8)	n.d.	n.d.
Sn	0.4	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	18.0 (16.0)	0.8	1.9 (2.1)
Ba	1	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	2 (4.9)	2	2 (2.9)
La	0.2	≤ LOD	205.0 (11.00)	63.0	72.8 (7.78)	≤ LOD	19.9 (3.70)	1.6	3.3 (0.92)
Ce	1.3	≤ LOD	487.0 (31.00)	174.0	193.9 (20.62)	≤ LOD	53.0 (18.00)	6.3	11.0 (2.84)
Pr	0.1	0.3 (0.14)	49.3 (3.80)	19.3	21.4 (2.37)	≤ LOD	9.1 (1.60)	0.9	1.4 (0.43)
Nd	0.5	1.9 (0.33)	103.1 (7.60)	55.0	55.8 (5.49)	≤ LOD	42.0 (10.00)	3.9	5.9 (2.18)
Sm	0.5	0.5 (0.27)	10.7 (1.60)	1.9	2.7 (0.74)	≤ LOD	32.0 (14.00)	1.7	2.9 (1.46)
Eu	0.09	≤ LOD	0.69 (0.17)	0.25	0.27 (0.11)	≤ LOD	≤ LOD	n.d.	n.d.
Gd	0.2	≤ LOD	7.3 (1.30)	0.8	1.4 (0.50)	≤ LOD	27.0 (12.00)	1.8	2.7 (1.34)
Tb	0.2	≤ LOD	0.5 (0.11)	0.3	0.3 (0.10)	≤ LOD	4.4 (0.73)	0.5	0.7 (0.29)
Dy	0.4	≤ LOD	2.1 (0.76)	1.0	1.1 (0.44)	≤ LOD	33.2 (9.80)	4.7	5.7 (1.87)
Ho	0.2	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	7.7 (3.40)	1.4	1.5 (0.48)
Er	0.3	≤ LOD	0.5 (0.20)	0.5	0.5 (0.20)	≤ LOD	32.0 (13.00)	5.9	7.0 (1.86)
Tm	0.3	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	7.3 (1.10)	2.1	2.3 (0.58)
Yb	0.3	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	89.0 (8.00)	25.3	27.6 (5.82)
Lu	0.5	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	14.9 (2.90)	4.9	5.4 (1.08)
ΣREE+Y		5.0 (1.9)	849.2 (34.0)	311.0	340.3 (22.5)	0.8 (2.9)	472.2 (45.2)	68.5	89.6 (8.1)

[1] The limit of detection (LOD) was calculated from repeated measurements of NIST 612;
[2] The means were calculated using data above LOD;
n.d. not determined.

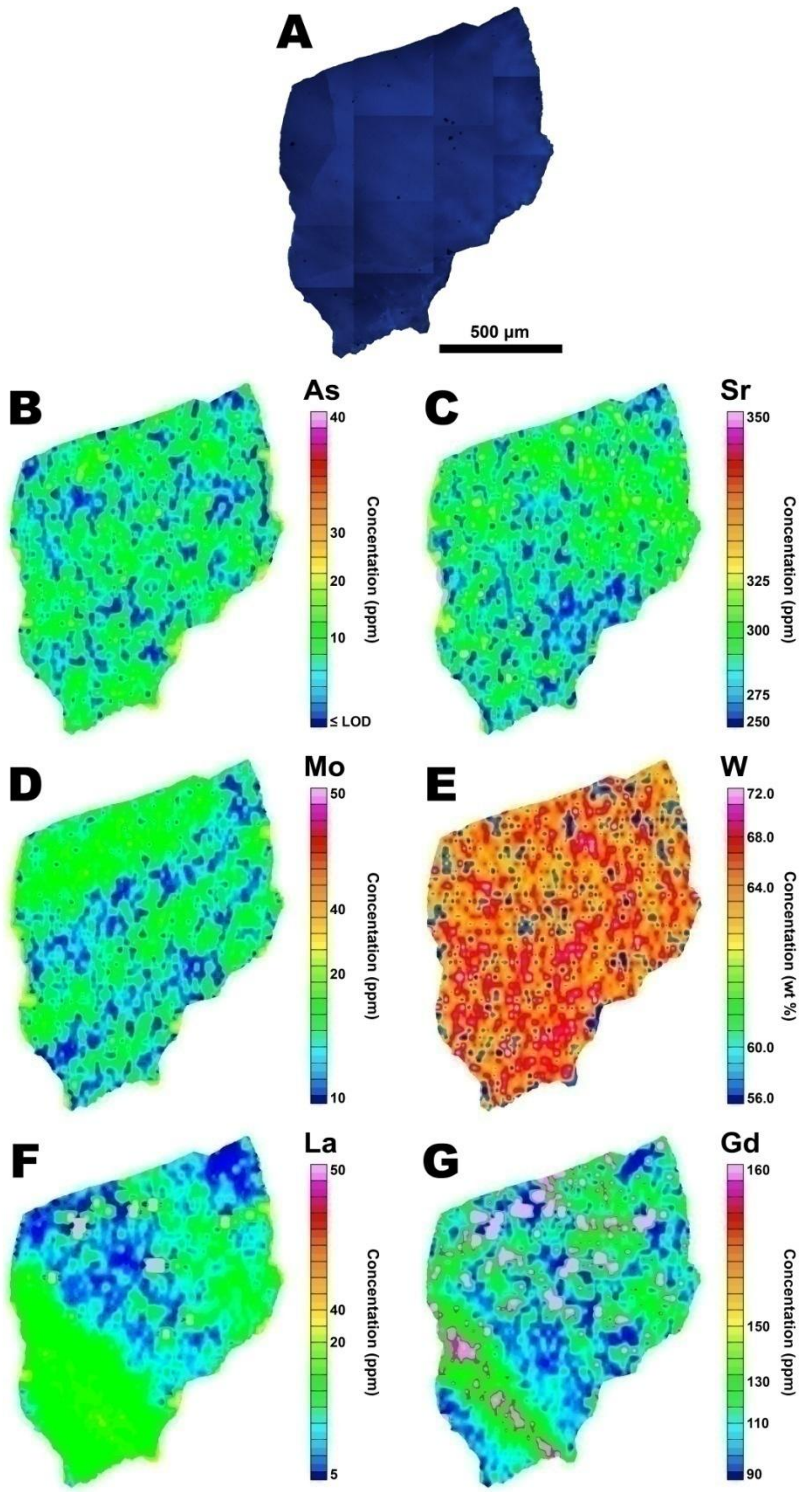

Figure 2.3: CL images and LA-ICP-MS maps of major and trace elements in scheelite from the Sigma Au mine, Québec, Canada. A. A composite image of scheelite with a relatively homogenous blue CL colour; B-E. The distribution of As, Sr, Mo and W respectively. The maps indicate all these elements are homogeneously distributed. F-G. The distribution of La and Gd, the highest concentrations being shown in warm colours (*e.g.*, in the bottom left of grain).

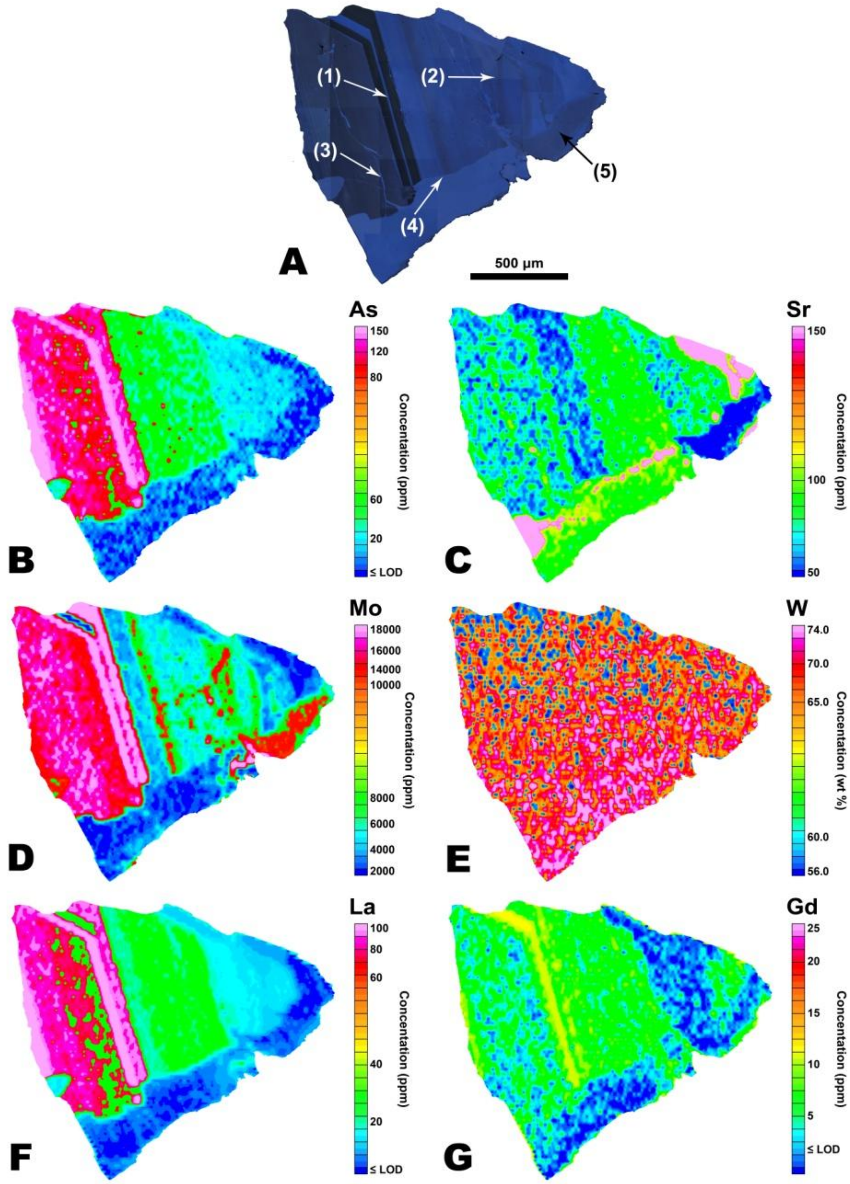

Figure 2.4: CL image and LA-ICP-MS maps of major and trace elements in scheelite from the Britannia mine, British Columbia, Canada. A. Internal structures of the scheelite grain as determined by CL showing: (1) regular (*i.e.*, constant width), sharp, and distinct contacts; (2) irregular and diffuse zones; (3) narrow, cross-cutting thin zones with bright CL; (4) a late overgrowth that partially the zoned grain; and (5) late stage overgrowth with a darker CL response of the late overgrowth. B. The distribution of As showing the highest concentrations (warm colours) on the left side of the grain and lowest concentrations (cool colours) within the late overgrowth (4). C. The distribution of Sr, which weakly correlates with the observed zonation pattern under CL. Note that the highest Sr concentrations occur along the margin of the overgrowth. D. The distribution of Mo. Note that this decreases from left to right with an absence of Mo within the late-stage overgrowth. E. The distribution of W in wt % which shows a general increase in the late stage-overgrowth. F. The distribution of La. Note the decrease in concentration from left to right and an absence within the late-stage overgrowth. E. The distribution of Gd. The distribution of which correlated with patterns observed under CL but the highest concentrations occur in small zone with a bright CL response, opposite to high La concentrations which are associated with dark spots.

2.4.3. Kumbel W-Cu-Mo Deposit, Kyrgyzstan

Scheelite from the Kumbel W-Cu-Mo skarn deposit (Kyrgyzstan; Rabchevsky 1988, Soloviev 1994, 2015) shows an oscillatory zonation pattern under CL (Fig. 2.5a). Using CL intensity as a discriminator, the zonation can be separated into several wide primary zones (Z1, Z2, Z3; Fig. 2.5a). These are arranged parallel to one another, with thicknesses ranging from 30 to 300 μm. Each of the generalized primary zones has a homogenous CL response, which can be can be further subdivided into numerous fine secondary bands (5 to 20 μm), as illustrated by the Z3 zone (Fig. 2.5a). Two late-stage crosscutting veinlets (V1, V2 in Fig. 2.5a) with comparable CL responses are present in the scheelite grain. The first (V1) is light blue and runs parallel to the primary zones, whereas the second (V2) is a slightly darker blue with respect to V1, and runs perpendicular and cross-cuts the primary zones. Based on the SEM-EDS maps, Mo and W were the only elements found to display zonation (Fig. 2.6). The REE, Y, As, and Sr occur below detection limits (*i.e.*, ≤0.2–0.3 wt. %).

This material exhibits variable Mo concentrations with an average of 9406 ± 1073 ppm and ranging from 3050 ± 230 to 14 300 ± 2000 ppm. Arsenic is also variable in its concentration with an average of 193 ± 220 ppm and ranging from bdl to 510 ± 31 ppm. Strontium is variable distributed with an average of 96.2 ± 10.3 ppm, although late-stage cross cutting veinlets possesses the highest concentrations up to 225 ± 21ppm). The ΣREE+Y concentrations average 322.2 ± 21.1 ppm and range from 5 to 849 ppm. While ΣREE+Y are homogenously distributed within a single zone, the can be heterogeneously distributed throughout the entire grain.

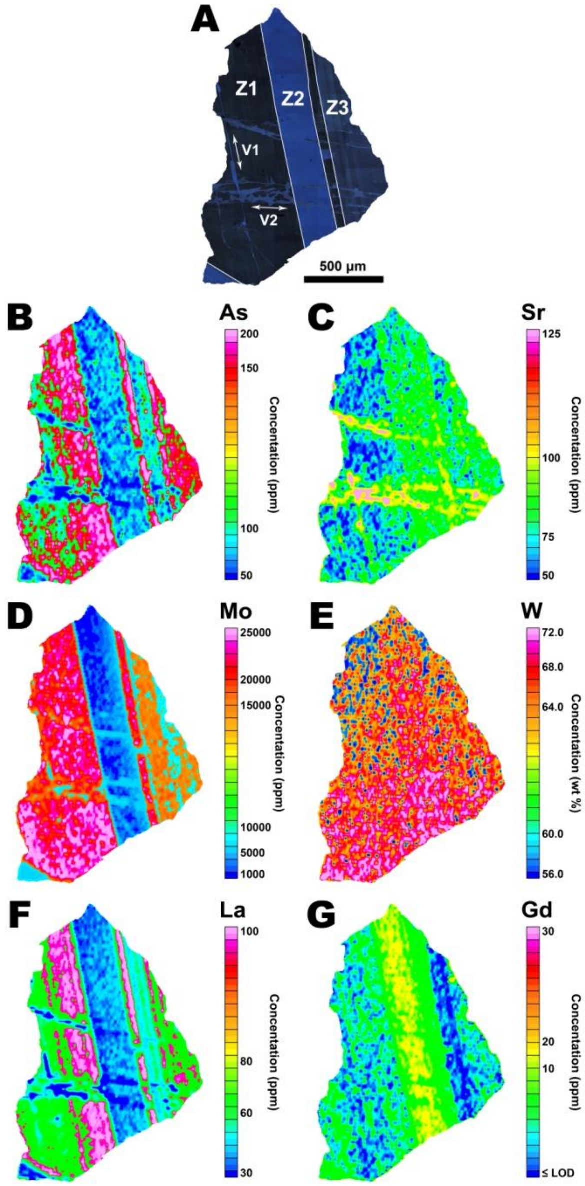

Figure 2.5: CL image and LA-ICP-MS maps of major and trace elements in scheelite from Kumbel, Kyrgyzstan. A. Three primary growth zones of the scheelite grain (denoted: Z1, Z2 and Z3) delineated by sharp parallel contacts as determined by CL. In addition, two late-stage, cross-cutting features (V1 and V2) with different orientations and CL responses (arrow) are present in the scheelite. B. The distribution of As closely mimic the CL responses with the highest concentrations (warm colours) occurring within dark CL response zones (Z1) and relative As depletion (cold colours) occurs within bright CL response zones (Z2). C. The distribution of Sr weakly follows zonation however the highest concentrations appear to follow the late stage cross-cutting features of V1 and V2. D. The distribution of Mo coincides with the CL zonation patterns, with high concentration associated with dark and depletion associated with bright CL responses. E. The distribution of W in wt. % are sporadic with a weak trend that shows an inverse correlation with Mo. F. The distribution of La follows zonation patterns; however it is sensitive to finer zones that are associated with high concentrations within Z1 and Z3. G. The distribution of Gd follows zonation patterns delineated by the CL response, however in contrast to La shows the high concentration in Z2.

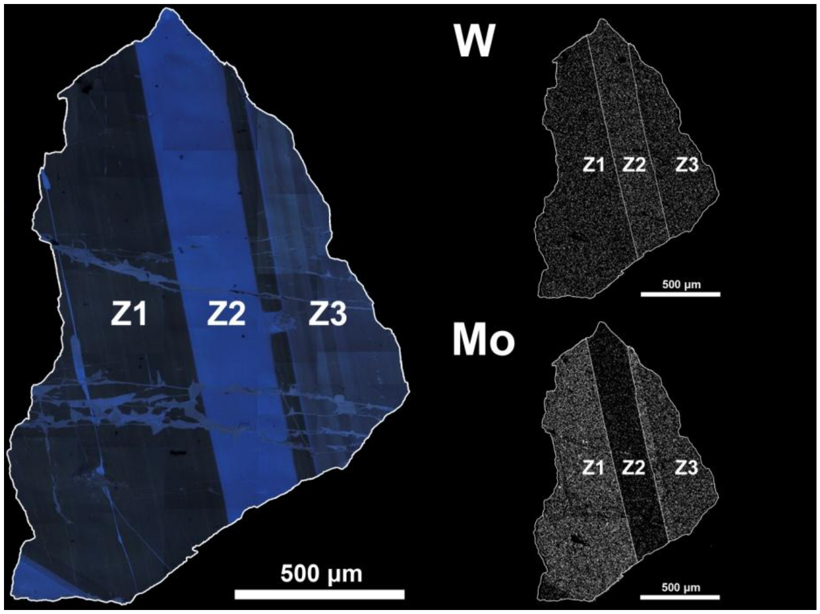

Figure 2.6: Comparison of CL response (left) and X-ray maps (right) of a scheelite grain from Kumbel, Kyrgyzstan. The three primary zones of the scheelite grain are denoted: Z1, Z2 and Z3. Qualitative X-ray maps are shown for W (upper right) and Mo (lower right) distribution in the scheelite grain. The X-ray maps indicate an inverse correlation between Mo-W content within scheelite. Note that the zones within the X-ray maps with light shades correspond to areas of relative enrichments of Mo and W. In contrast zones with dark shades indicate a relative depletion in Mo and W.

2.4.4. Zinnwald–Cínovec Deposit, Germany–Czech Republic

Two scheelite samples from the greisen deposit of Zinnwald–Cínovec (Germany–Czech Republic; Durisoval *et al.* 1979, Štemprok 1986, Webster *et al.* 2004) were examined, both showing complex internal textures and CL responses (Fig. 2.7, 2.8). The zonation observed under CL is well-developed at two scales: (1) broad, regular primary zones ~100 μm wide that are defined by large shifts in colour, and (2) narrow secondary (5-10 μm) oscillatory bands. In general, the CL responses of the various zones display minor changes from light to dark blue, with both having dendritic- or feather-like intergrowths (Figs. 2.7a, 2.8a). In addition, one of the grains shows significant internal fracturing and a number of crosscutting veinlets. Textures similar to this were not observed in any other scheelite grains examined in this study and may therefore be unique to this locality.

Scheelite from the Zinnwald–Cínovec deposit exhibits the most complex CL zonation patterns observed in this study, along with showing exceptionally large ranges in elemental abundances. The concentration of Mo and As show significant variability with an average of 14601 ± 2567 ppm for Mo (ranging from 520 ± 220 to 67 900 ± 8600 ppm) and 747 ± 143 ppm for As (ranging from 178 ± 22 to 2320 ± 700 ppm). Strontium is also variable within a single scheelite grain with an average of 296.6 ± 42.8 ppm and ranging from 86.0 ± 13.0 to 696.0 ± 54.0 ppm. Furthermore, the LA-ICP-MS maps reveal a large variability in concentrations between zones. Interestingly, the distribution of Sr does not follow the same chemical zones as delineated by other elements (*e.g.*, Mo, As, La, Gd). This is especially apparent in Figure 2.8d, where the Sr concentrations appear diffuse across multiple zones. The ΣREE+Y vary, with individual zones averaging 90 ± 8 ppm and range from bdl to 472 ± 45 ppm.

2.5. Discussion

In this study, the dominant CL response observed is predominantly blue but that subtle variations of this can vary even within a single grain, revealing exceptionally complex patterns. A variety of elements have been documented to be capable of impacting on the luminescent properties of minerals (*e.g.*, Uspensky *et al.* 1998, Habermann 2002, Gaft *et al.* 2005, MacRae and Wilson 2008, Götze 2012). The observed CL response of scheelite can be considered as being the product of one or more mechanisms, including: (1) self-activated emission band (SB), which is associated with the WO_4^{2-} group and considered to be the primary cause for the blue luminescence; (2) impurities such as Mo, As, Sr which can directly or indirectly modify the

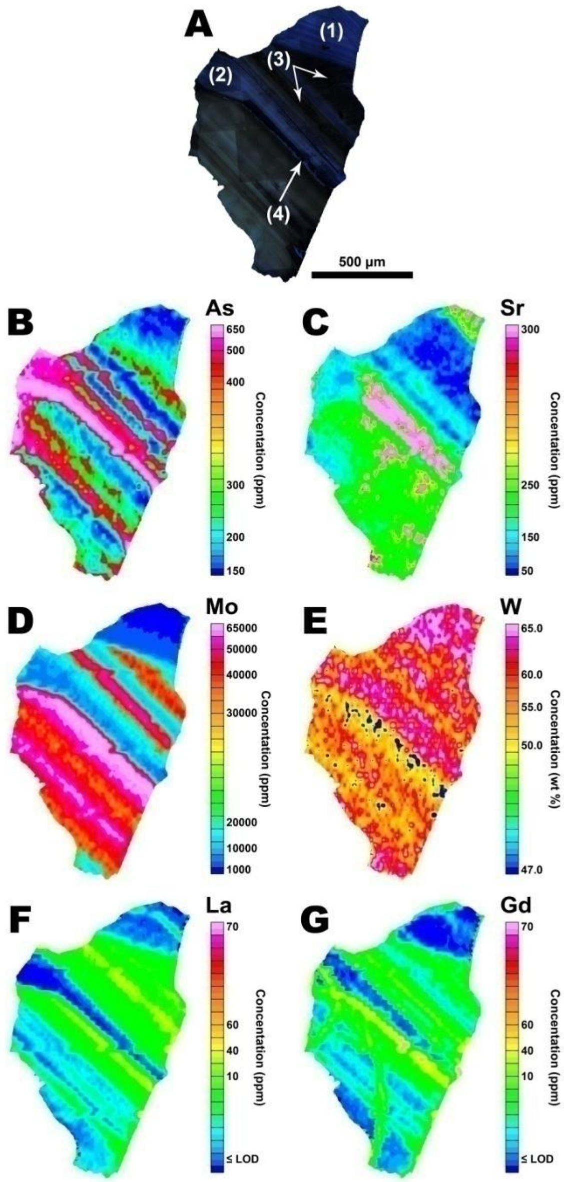

Figure 2.7: CL image and LA-ICP-MS maps of major and trace elements in scheelite sample (CMN80145A) from Zinnwald–Cínovec, Germany–Czech Republic. A. Internal features and textures of the scheelite grain as determined by CL noting: (1) and (2) comparable CL responses both in colour and intensity, (3) A feather-like intergrowth of light- and dark-blue coloured zones that occurs in the zone noted by the arrow; and (4) denoted by the arrow is a dissolution feature following a zone. B. The distribution of As, which correlates with the observed zonation pattern under CL. Note that zones with similar CL responses [noted as (1) and (2) on A] show both high (warm colours) and low (cool colours) concentrations of As. Minor enrichments of As are associated with the main fracture noted (4). C. The distributions of Sr, which shows an erratic behaviour with respect to the zonation patterns revealed by CL imaging. Note that the upper right portion of the grain shares a similar disjointed pattern distribution as observed for As in B. D. The distribution of Mo, which mimics the delineated zones as determined by CL. The distribution of W in wt. % are sporadic, however there is an inverse correlation between W and Mo. F-G. The distribution of La and Gd follow the zonation patterns defined by the CL response. In addition, the Gd concentration is most elevated within the fracture noted (2).

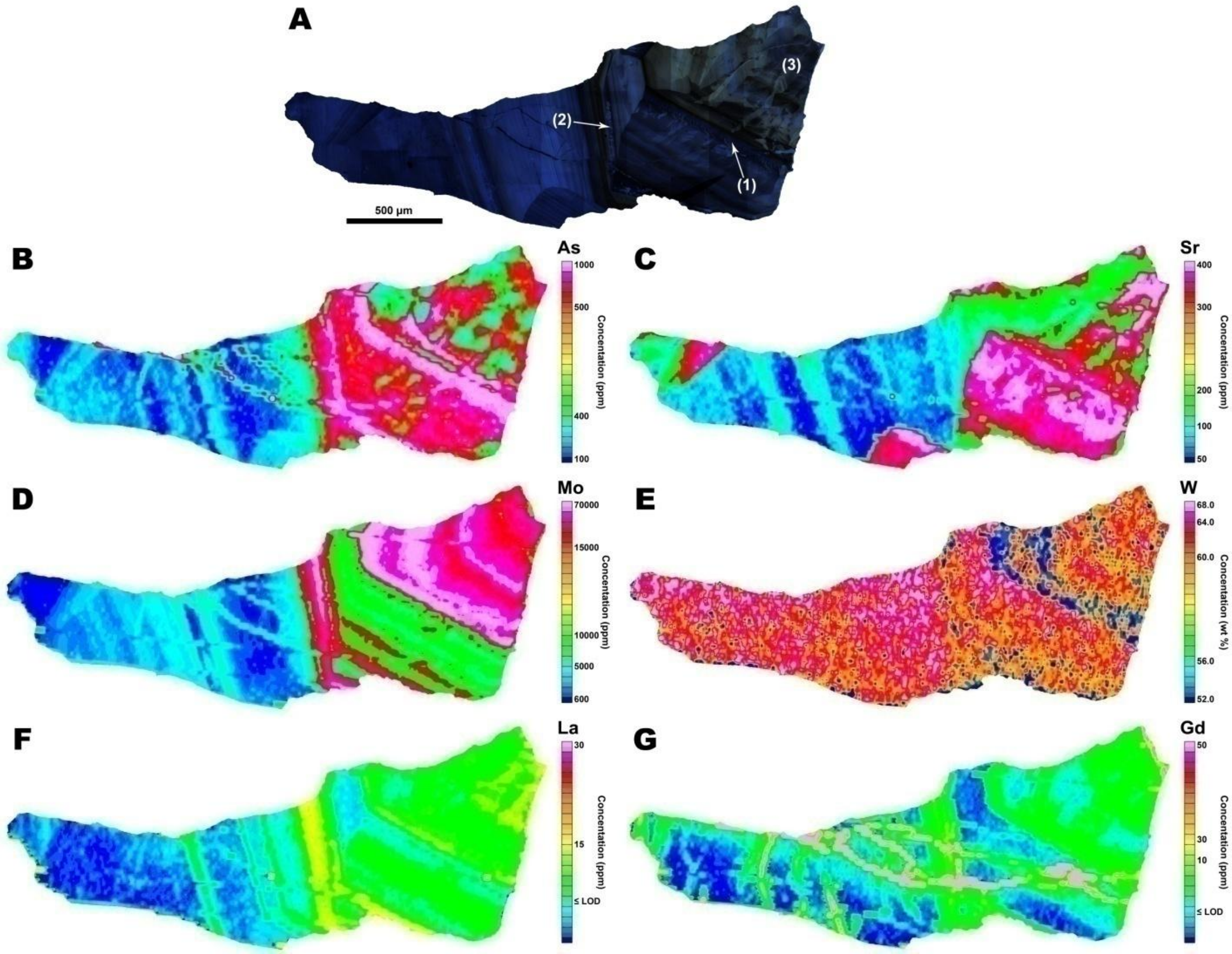

Figure 2.8: CL images and LA-ICP-MS maps of major and trace elements in scheelite sample (CMN80145B) from Zinnwald–Cínovec, Germany–Czech Republic. A. Internal structures of the scheelite grain as determined by CL indicate an oscillatory zonation pattern varying from dark- to light-blue. In addition, featherlike intergrowths of black- and dark-blue CL response, as denoted by the arrows (1) and a fine zone of dissolution-like textures denoted (2). B. The distribution of As varies with the zonation patterns observed under CL, however there is no clear correlation between the CL response and As content. C. The distribution of Sr varies as they rarely follow the defined zonation pattern and appear diffused or disjoint across multiple zones. D. The distribution of Mo varies in conjunction with the observed zonation patterns under CL. E. The distribution of W in wt. % are variable; it is noteworthy that there is a clear inverse correlation between W and Mo as zones with low W concentrations (cool colours) are associated with zones of high Mo concentrations. F-G. The distribution of La and Gd follow the zonation pattern observed under CL. In addition, high concentrations of Gd are associated with the dissolution-like textures (2) and fractures (3).

observed luminescence; and (3) transition elements, in particular the REE, which are important activators in a variety of other minerals (*e.g.*, apatite, fluorite, calcite; Götze *et al.* 1999, Machel 2000, Kempe and Götze 2002, Schwinn and Markl 2005). The relationships among the observed CL responses, the textures they reveal and the corresponding crystal chemistry of the scheelite will be briefly discussed. In addition, how these collectively reflect changes in the physico-chemical conditions under which scheelite develops will also be explored.

2.5.1. Self-activated emission band (SB)

The CL response observed in scheelite is dominated by the superimposition of two types of luminescence: (1) the SB and (2) other CL activators (*e.g.*, REE^{3+}). Determining which REE impact most significantly on the CL response observed for scheelite is hindered by the lack of spectral data. This is further compounded by the fact that the SB-dominated CL spectra are broad, thus masking the characteristic peaks associated with individual REE^{3+} activators (*e.g.*, Tm^{3+} – 453 nm, Pr^{3+}– 487 nm, Er^{3+}– 520 nm, Tb^{3+}– 544 nm, Dy^{3+}– 574 nm, Eu^{3+}– 615 nm, Sm^{3+}– 643 nm; Uspensky *et al.* 1998, Brugger *et al.* 2000*a*, *b*). A reduction of the overall effectiveness (or intensity) of the SB band due to a decrease of W concentration (*via* substitution) could decrease the intensity of the CL response thus potentially enhancing the effects of weaker CL activators.

The $W^{6+} \leftrightarrow Mo^{6+}$ substitution in scheelite is common and results of this study suggest increases in Mo content correlate with a decrease in the CL intensity, this being most evident in material from Zinnwald–Cínovec (Fig. 2.7). This conclusion is based on comparing the Mo LA-ICP-MS map and the corresponding CL image (Fig. 2.7a) which show a negative correlation between CL intensity and Mo concentration. This arises because a reduction in the W content decreases the overall impact of the WO_4^{2-} SB on the observed luminescence, the reasons behind which may be due to one or more factors. Furthermore, the introduction of Mo into the scheelite structure could lead to a greater distortion of the crystal structure but since the two possess near identical radii ($^{[4]}rMo^{6+}$ = 0.41 Å *versus* $^{[4]}rW^{6+}$ = 0.42 Å; Shannon 1976), this is unlikely. Secondly, the higher emission energy for the tungstate group (WO_4^{2-}; 425 nm; 2.92 eV) *versus* a molybdate group (MoO_4^{2-}; 530 nm; 2.34 eV) permits for a one-way migration of the energy from the tungstate to molybdate group which would cause an attenuation of any emission (*i.e.*, luminescence), the result of which would shift the luminescence spectra towards longer wavelengths (Tyson *et al.* 1988, Zhang *et al.* 1998).

2.5.2. Elemental Impurities

It has been recognized that scheelite exhibits the same luminescent response whether exposed to an electron beam or UV excitation source (Shoji and Sasaki, 1978), which in turn suggests that it is the same mechanism that is causing the changes in luminescence independent of the excitation source. Results from the LA-ICP-MS analyses indicate that the largest chemical variations in scheelite involve Mo, As, and Sr. There are significant differences in ionic radii of Sr and As as they substitute for Ca and W, respectively. General effects on the CL response of scheelite owing to the incorporation of these elements are now further explored.

Based on the SEM-EDS maps (Fig. 2.6) of scheelite from Kumbel, Mo and W were the only elements found to display zonation patterns. The X-ray maps for W and Mo indicate an inverse relationship between the two, consistent with solid solution between scheelite and powellite. When comparing the Mo X-ray map with the corresponding CL image, it is clear that there is also an inverse correlation between CL intensity and Mo enrichment. Furthermore, the

Mo X-ray map (Fig. 2.6) corroborates with LA-ICP-MS map of the corresponding grain (Fig. 2.5d), albeit lacking some of the fine-scale spatial distributions of Mo. The agreement between these two methods suggests a viable option in terms of delineating zonation patterns using SEM-EDS X-ray mapping.

The substitution of As^{5+} for W^{6+} into scheelite would decrease the impact of the WO_4^{2-} centres present, which would in turn yield a reduced CL response. Scheelite from the Zinnwald–Cínovec Sn-W greisen deposit (Fig. 2.7a) displays a complex CL zonation varying from bright to dark blue. Data from LA-ICP-MS analyses for As reveals that this scheelite exhibits both enrichments (~ 500 to 600 ppm) and depletions (≤150 ppm), although no correlation between As content and CL response is noted (Fig. 2.7b). Thus, despite differences in As content within zones of similar CL responses, *i.e.*, the same CL response is given by areas of low As concentrations (≤200 ppm) as that of areas of high As concentrations (≥500 ppm), suggesting that the substitution of As for W, at the concentration involved, have no visible effect on the CL response of scheelite.

The isovalent substitution of Ca^{2+} and Sr^{2+} is common in scheelite. While Sr^{2+} may not be considered as an extrinsic defect (generate a luminescent centre) due to its electronic configuration, it may however be linked to intrinsic defects (*i.e.*, lattice distortions) given differences in their ionic radii ($^{[8]}r\text{Ca}^{2+}$ = 1.12 Å *versus* $^{[8]}r\text{Sr}^{2+}$ = 1.26 Å; Shannon 1976). Furthermore, the impact of crystal-structure distortions and defects, including structure defects induced by twinning, mechanical deformation, radioactivity or rapid growth have been linked to variations in CL response, for example, the brown to reddish-brown CL response in quartz (Ramseyer *et al.* 1988, Götze *et al.* 2001, Botis *et al.* 2005, Pan *et al.* 2006). Based on the LA-ICP-MS maps (Fig. 2.3-5, 2.7-8), zones with an enrichment of Sr do not correlate with any single type of CL response. However a number of textures observed in the scheelite grains under CL can be associated with an enrichment of Sr, such as the featherlike intergrowths or internal fracturing observed at Zinnwald–Cínovec (Fig. 2.8), late-stage overgrowth from Britannia (Fig. 2.4), or cross-cutting veinlets from Kumbel (Fig. 2.5). While there is no direct correlation between Sr concentration and CL intensity, it can be noted that a number textures observed under CL are associated with elevated concentrations of Sr, suggesting the influence of Sr as an intrinsic element within scheelite.

2.5.3. Rare-earth elements and yttrium

As previously mentioned, the LREE (La-Nd) preferentially substitute over the HREE (Ho-Lu) owing to the similarity of their ionic radii relative to Ca^{2+} ($^{[8]}r Ca^{2+}$ = 1.12 Å *versus* $^{[8]}r La^{3+}$ = 1.16 Å and/or $^{[8]}r Lu^{3+}$ = 0.98 Å; Shannon 1976). As the substitution of $REE^{3+} \rightarrow Ca^{2+}$ is not isovalent, a coupled substitution mechanism is required. This could occur via: (1) $2Ca^{2+} \leftrightarrow Na^{+} + REE^{3+}$, (2) $Ca^{2+} + W^{4+} \leftrightarrow REE^{3+} + Nb^{5+}$ or (3) $3Ca^{2+} \leftrightarrow 2REE^{3+} + \square$ (where □ is a site vacancy; Ghaderi *et al.* 1999). To determine which operates in scheelite and to evaluate the impact that variations in ΣREE+Y content could have on the nature of the CL response in scheelite, material from the Sigma mine was selected as: (1) it is chemically homogenous in terms of major, minor and trace-element concentrations (Table 2.3); (2) does not exhibit any significant zonation and produces a uniform CL response, all of which make it an ideal baseline-material from which more complicated issues can be discussed, (3) furthermore, it is near end-member in composition, with very low concentrations of cations substituting for W (As and Mo are both ≤17 ppm) and Ca (Na and Sr are both ≤290 ppm); (4) it also exhibits the highest ΣREE+Y contents in scheelite examined in this study, with an average of 990.2 ± 2.8 ppm ranging from 838.0 ± 2.2 to 1077.0 ± 3.3 ppm (Table 2.3). It exhibits a blue CL response which could be attributed to: (a) SB effects; (b) ΣREE+Y content; or (c) a combination of both (a) and (b). As previous studies have demonstrated, the ΣREE+Y content in scheelite has a role on the luminescence spectra, however the observed CL response from scheelite from Sigma Au mine (*i.e.*, blue) is that typically observed in scheelite, suggesting that any modification or alteration of the CL response is mute at the concentrations observed in this study as such the scheelite from the Sigma Au mine can be considered as a end-member scheelite in terms of CL response. Scheelite from Zinnwald–Cínovec displays zones with CL responses as those observed in material from the Sigma mine. However, this scheelite has lower ΣREE+Y concentrations (up to 472.2 ± 45.2 ppm; Fig. 2.8f, g) thus, these are unlikely to be the cause for prominent zonation patterns observed under CL. Scheelite from Kumbel have comparable ΣREE+Y concentrations (up to 849 ± 34 ppm); however, there is a decoupling between the LREE elements (La-Nd; Fig. 2.5f) and the MREE (Sm-Dy; Fig. 2.5g), which are associated with zones of dark and bright CL response, respectively. At the Britannia mine (Fig. 2.4), a late-stage overgrowth is evident. This zone is depleted in minor and trace elements, with the exception of some sporadically distributed Mo and Sr (Fig. 2.4). It is noteworthy that this scheelite exhibits a strong blue colour under CL, comparable to that observed at Sigma, suggesting that the dominant effect of CL colouration is most likely attributable to the SB. While observations support that SB effects are important contributors to CL response, it is unclear as to whether the ΣREE+Y play a major or minor role in modifying the colour or intensity of the CL response. It is noteworthy however that even in high concentrations of ΣREE+Y, such as observed at Sigma Au mine, the presence of a strong, broad SB can impede the recognition of subtle change in colour or intensity shift in the resultant

CL response of scheelite. The effect on the CL response is due to the incorporation of ΣREE+Y thus may be regarded as negligible owing to the overwhelming nature of the SB.

2.5.4. System dynamics

The presence of oscillatory zoning as evidenced by CL and trace-element chemistry in scheelite, reflects changes in the physico-chemical conditions of formation, including changes in fluid chemistry. In this study, and also noted by others (*e.g.*, Shore and Fowler 1996, Brugger *et al.* 2000*a*, *b*), zonation patterns can range from being relatively simple (*e.g.*, Kumbel) to highly complex (*e.g.*, Zinnwald–Cínovec). Such ranges facilitate comparison of scheelite from differing ore-deposit settings and provide a mechanism by which a better understanding of the genesis and evolution of these ore deposits may be obtained.

Oscillatory zoning in scheelite from porphyry and skarn systems was commonly observed in this study, but absent in those from orogenic Au deposits. Oscillatory zoning reflects the presence of multiple, compositionally different growth-shells or layers; although the term "oscillatory" is used, the fluctuation in zone thickness and composition need not be regular or harmonic (Shore and Fowler 1996). Oscillatory zonation in minerals is binary, *i.e.*, the short-range zoning varies between two consistent or gradually varying compositional end-members; in this study, these are considered to mainly be between scheelite, $CaWO_4$ and powellite, $CaMoO_4$, as among the trace-elements present in scheelite, Mo is predominant. Shore and Fowler (1996), in their examination of zoning in 75 minerals covering a wide-range in chemistries (*e.g.*, silicates, carbonates, phosphates) suggest that oscillatory zoning is a primary growth texture favoured by moderately rapid growth, with the composition of each layer controlled by local *P-T-X* conditions. It was also noted that hydrothermal alteration and/or recrystallization may overprint or eliminate fine-scale zoning. In this context, we examine the scheelite grains that were imaged and mapped and discuss the results in the context of zoning and paragenesis.

The Sigma Au mine is an example of a greenstone-hosted, quartz-carbonate vein deposit (orogenic Au) formed by the circulation of hydrothermal fluids of metamorphic origin (Olivo *et al.* 2006). Results from this study show that scheelite from here is near end-member in composition, lacks detectable concentrations of many trace-elements (*e.g.*, Mo, As), and shows no discernible zonation under CL (*i.e.*, homogenous blue; Fig. 2.3a). The homogenous CL response observed in this scheelite (Fig. 2.3a) is also commonly observed in quartz from orogenic Au veins (Rusk 2012). The homogenous CL responses observed may be primary precipitation features, suggesting a lack of intrinsic or extrinsic defects commonly associated with minerals precipitating under stable conditions (*e.g.*, pegmatic quartz under high temperature and pressure conditions; Götze *et al.* 2005, Rusk 2012). Alternatively, homogenous CL responses are characteristic of quartz from metamorphic rocks (Seyedolali *et al.* 1997, Boggs *et al.* 2002), where the lack of texture is due to annealing of CL textures resulting from redistribution of lattice defects and trace elements concentrations under metamorphic conditions (Sprunt *et al.* 1978, Spear and Wark 2009). At this point, it is unclear as to whether scheelite from the Sigma Au mine developed with little or no CL texture or whether a previously existing CL texture was developed as a result of annealing or complete recrystallisation. Data from the fluid-inclusion and isotope studies of scheelite from this mine given by Olivo *et al.* (2006) suggest that it formed from a single low-temperature fluid (<200 °C) during the advanced stages of regional deformation. As such, the scheelite from Sigma mine may have also developed from a single homogenous fluid with limited variation in intensive parameters during its crystallization resulting in a primarily homogenous CL response.

The Kumbel skarn deposit contains multiple generations of scheelite mineralization that are divided between two ore zones: (1) that associated with retrograde skarn development; and (2) that occurring within a quartz stockwork zone (Soloviev 2015). A fluid-inclusion study of scheelite from this locality (Soloviev 2015) suggests involvement of high-*T* (up to 600°C) and high-salinity (40-60 wt. % eq. NaCl) fluids. Scheelite from the Kumbel skarn deposit shows numerous, broad (≤ 300 μm) primary zones, (Fig. 2.5a) that correspond to changes in chemistry, in particular, Mo content (Fig. 2.5d). Data from Soloviev (2015) indicates that Mo concentrations in scheelite vary from 0.1 – 0.4 wt. % in the quartz stockwork zone, to 1.3 – 2.5 wt. % in that from a retrograde skarn. This is consistent with the patterns of Mo content in scheelite from the Kumbel skarn deposit obtained in this study, *i.e.*, there are two generations of scheelite, each with its own characteristic Mo content and each of which can be recognised as distinct zones in a single scheelite grain, based on both their CL response and LA-ICP-MS maps (Fig. 2.5a, d). In fact, an additional third stage of hydrothermal activity is also revealed by the CL imaging, this appearing as veinlets that cross-cut earlier-formed zones (Fig. 2.5a).

As previously discussed, changes in fO_2 may influence the Mo content of scheelite, this is because an environment of high fO_2 and low fS_2 would favour stability of the powellite component in scheelite while an environment of low fO_2 and high fS_2 would favour stability of molybdenite (Fig. 2.1; Hsu and Galli 1973). Conditions of the fO_2 and fS_2 in a mineralizing system are affected by a variety of factors, including: oxidation state of the host rock and pluton, deep *versus* shallow systems, all of which in turn will directly affect the Mo content present in scheelite during its formation. The sharp boundaries between zones observed under CL in scheelite from Kumbel suggest one or more of the following: (1) the presence of an evolving magmatic-hydrothermal system with distinct changes in the Mo content of the fluid from which the scheelite was deposited, (2) alteration of the scheelite, resulting in development of a Mo-depleted zones and (3) distinct states in the oxidation conditions (fO_2 and/or fS_2) creating banding of Mo-rich and Mo-depleted zones.

Scheelite from the Britannia mine is considered to have formed during the late-stage remobilization of the primary Cu-Zn ore-body (Payne *et al.* 1980). The minerals paragenetically associated with scheelite (realgar, orpiment, fluorite, pyrolusite) suggest it formed in a near-surface, lower *T* zone (Payne *et al.* 1980). Scheelite from this deposit shows an important feature not observed at the other deposits, this being the presence of a late-stage overgrowth of scheelite (Fig. 2.4). The overgrowth is near end-member in composition, and is chemically distinct from the primary scheelite in that it has variable contents of Mo, As, and ΣREE+Y (Fig. 2.3b-g). In fact, we suggest that the combination of CL and LA-ICP-MS maps can provide exceedingly detailed insights in the growth history of mineral like scheelite. For example, the Mo map of this grain (Fig. 2.4d) reveals areas (right part of the grain) that are enriched in Mo, which may represent an overprinting or remobilization of a Mo-rich area. In contrast, the LA-ICP-MS map of La distribution (Fig. 2.4f) does not correlate with those of Mo, suggesting a decoupling of these trace elements, possibly due to an overprinting of a REE-rich fluid. Such a fluid would have presumably developed at low-*T*, since REE are relatively immobile in low *T* fluids and, thus, better preserve the original zoning (Michard and Albarède 1986, Carcangiu *et al.* 1997, Fulignati *et al.* 1999, Scambelluri *et al.* 2001). However, the general decrease in La concentration (Fig. 2.4f) may also reflect conditions at the time of precipitation. The presence of REE-enriched and REE-depleted zones within a single scheelite grain may reflect the following: (1) the co-precipitation of a mineral which strongly partitions REE (*e.g.*, calcite, apatite, fluorite); (2) a decrease in the total concentration of REE with increasing pH of hydrothermal fluids (Schwinn and Markl 2005); (3) the REE concentration is associated with late-stage fractionation of REE in the granite magmas by magmatic-hydrothermal fluids (Dolejs and Štemprok 2001); (4) changes in crystallization speed and or growth kinetics or (5) a change in the overall *P*-*T*-*X* conditions.

Scheelite from the high-*T*, Sn-W greisen deposit of Zinnwald–Cínovec exhibits some of the most intricate zonation, based on CL imaging (Figs. 2.7a, 2.8a) and LA-ICP-MS (Figs. 2.7b-g, 2.8b-g) elemental mapping. Whereas cyclic variations in CL response and chemistry are beneficial to unravelling potential effects of activators and quenchers, the complex zoning observed in this material is uncommon among the scheelite examined in this study. As the Sn-W deposit of Zinnwald–Cínovec is considered to have been a product of multiple W-bearing fluids (Štemprok & Šulcek 1969, Johan *et al.* 2012), so the observed complex zonation as shown in the CL images in the scheelite from this locality may reflect this. Interpretation of the zonation is not simple and may reflect either multiple pulses of fluid with fluctuating chemical properties and depositional conditions (*e.g.*, *T*, *P*, pH, and fO_2) could contribute to the cyclic nature of the zones, as discussed by Brugger *et al.* (2000*b*) or modification of the pre-existing scheelite by late-stage fluids in the ore-system.

2.6. Conclusions

Cathodoluminescence can be an efficient technique for determining the zonation patterns and growth history of minerals like scheelite, especially when combining with trace-element LA-ICP-MS analyses, traditionally unobservable using conventional microscopy methods. This work illustrates the strength of combining CL and trace-element mapping on a single heterogeneous mineral, such as scheelite.

(1) All of the scheelite grains observed in this study exhibit a strong CL response, varying in colour from dark to light blue, however exhibit a wide variation in zonation patterns, ranging from being absent to extremely complex oscillatory zoning ranging from <1 μm to >300 μm.

(2) In some cases the results from LA-ICP-MS analyses show significant chemical variations in scheelite with respect to Mo, Sr, As, and ΣREE+Y both between different deposits and within a single grain.

(3) Maps generated from CL-imaging and LA-ICP-MS data reveal a strong, negative correlation between the intensity of the CL response in scheelite and Mo content. While enrichments of Sr, As, and ΣREE+Y are noted, none exhibit a correlatable effect with CL response.

(4) By combining both CL and trace-element chemistry, provides a means by which the chemical mechanism behind CL response could be evaluated. The trace-element data also facilitated differentiation between primary *versus* secondary growths and textures observed under CL.

(5) The presence or absence of zonation, can be useful in discriminated between scheelite arising from differing mineralized environments. Scheelite from orogenic Au systems, possess a homogenous CL response relative to that from skarn, porphyry-related, and greisen systems, which possess variable oscillatory zoning patterns.

CHAPTER 3:

SCHEELITE THROUGH THE LOOKING GLASS: DETERMINING ORE SYSTEMS USING GEOCHEMISTY AND OXYGEN ISOTOPES

3.1. Introduction

As part of the Geological Survey of Canada's (GSC) Targeted Geoscience Initiative (TGI-4) program, a project was developed to evaluate the potential use of scheelite as a resistant indicator mineral (RIM) for base-metal exploration, which followed on similar such research using other mineral phases (e.g., garnet, chromite, olivine, clinopyroxene, and ilmenite; McClenaghan & Cabri 2011; McClenaghan *et al.* 2001, 2009, 2014; Carmody *et al.* 2014). A large suite of scheelites collected from diverse ore deposit settings was assembled and analysed for trace-element chemistry and element distribution patterns using laser ablation inductively coupled mass spectrometry (LA-ICP-MS). A sub-group of samples was used to assess the range of $\delta^{18}O$ values in this same mineral as a further potential discriminant given the limited amount of previous work in this area also.

Potential RIMs have been identified for a range of deposit types, including rutile (Meinhold *et al.* 2008; Újvári *et al.* 2013), chromite (Griffin & Ryan 1995; Locmelis *et al.* 2013), tourmaline (Henry & Guidotti 1985; van Hinsberg & Schumacher 2011; van Hinsberg *et al.* 2011), garnet (Griffin & Ryan 1995; Heimann *et al.* 2011), magnetite (Boutroy *et al.* 2014; Dare *et al.* 2014), and apatite (Belousova *et al.* 2002; Sell & Samson 2011). Most recently, titanite has shown promise as an ore deposit discriminator (Wang *et al.* 2011; Che *et al.* 2013; Celis 2015; Xu *et al.* 2015).

The low detection limits associated with LA-ICP-MS analyses has revolutionised the understanding of trace element patterns and concentrations in a variety of minerals of relevance to ore deposit systems. The results of this work has shown that in some cases the trace element chemistry of phases, such as magnetite and pyrite, have potential to be applied as process discriminators (magnetite: Dupuis & Beaudoin 2011; Dare *et al.* 2014; pyrite: Large *et al.* 2009; Duran *et al.* 2015). Furthermore, the trace element composition of single pyrite crystals has been shown to trace a protracted paragenesis, providing therefore insight into ore formation processes (e.g., Large *et al*. 2009; Thomas *et al.* 2011; Agangi *et al.* 2015; Steadman *et al.* 2015).

The essential requirements for a useful RIM include: (1) its widespread distribution in relevant rock types; (2) a compositional range that reflects the conditions of ore formation; (3) its ability to survive weathering and transport; and (4) its relative ease of recognition, separation, and analysis (McClenaghan *et al.* 2000; Averill 2001; McClenaghan & Kjarsgaard 2007). Scheelite ($CaWO_4$) has all of these attributes, which make it a potential RIM, but there has been little consideration of it in this capacity (see McClenaghan *et al.* 2012 for a recent summary), despite the fact that it is a common and economically important ore mineral in skarn and porphyry deposits (e.g., Allen & Folinsbee 1944; Newberry & Swanson 1986; Larsen 1991; Sinclair 2007); it is found in both orogenic (Craw & MacKenzie 1992; Bierlein & Crowe 2000; Goldfarb *et al.* 2005; Laznicka 2006; Pitcairn *et al.* 2006) and intrusion-related gold deposits (Hart 2007), and also in deposits of more enigmatic origins (e.g., Dill *et al.* 2008; Dill 2010). In its other oxide form (i.e., wolframite), W is present in both vein and greisen deposit settings (e.g., Bray & Spooner 1983; So & Yun 1994; Gao *et al.* 2014). In general, it is well established that W is spatially and temporally related to a variety of important commodities (Au, Mo, Cu, and Sn) in a variety of ore deposit settings, which means that scheelite has use as both a RIM but may also offer the potential to discriminate among ore deposit settings.

Previous work on scheelite applied to ore deposits included its use as a geochronometer (Nd-Sm dating; Bell *et al.* 1989; Anglin *et al.* 1996; Roberts *et al.* 2006), indicator of *P-T-X* conditions *via* fluid inclusion studies (Landis & Rye 1974; de Ronde *et al.* 2000; Goryachev *et al.* 2008), and application as a fluid tracer using $\delta^{18}O$ (Landis & Rye 1974; Higgins & Kerrich 1982; Shelton *et al.* 1987; Vander Auwera & Andre 1991; Kontak & Kerrich 1997; Goryachev *et al.* 2008) and trace element chemistry (e.g., Vander Auwera & Andre 1991; Brugger *et al.* 2000*a*, *b*; Roberts *et al.* 2006; Goryachev *et al.* 2008; Dostal *et al.* 2009; Song *et al.* 2014).

In this study we present the geochemical component of an integrated study on the nature of cathodoluminescence (CL) and chemistry of scheelite with the intent of assessing its potential as an ore deposit discriminator. The results of the first part of this study have been presented elsewhere (Poulin *et al.* 2016) and here we focus on latter aspect using trace element data acquired using LA-ICP-MS and also $\delta^{18}O$ data.

3.2. Sampling and deposit classification

This study examines scheelite from a broad range of ore deposit settings. Although the emphasis is on orogenic and skarn deposits due to the fact that scheelite is more abundant in such settings, material from porphyry-related, griesen, and volcanic-associated massive sulphide deposits is also included. The relevant information for each of the sites, such as location, age, style of mineralization mineral assemblage(s) and paragenesis, as derived from existing literature descriptions, is summarized in Table 3.1.

Table 3.1. A summary of relevant geologic information for the scheelite samples used in this study, as compiled from the literature and the work reported in this paper.

Deposit[1]	Country	Commodity[2]	Age of Mineralization[3]		Type of Mineralization	Host Rock(s)	Intrusion Type	Alteration	Principal Mineral Assemblages[4]	References
Barewood *(D)*	New Zealand	Au (W)	ECRET (125 Ma)	Metamorphic	Turbidite-hosted	MetaGwke	n.d.	Silicic, argillic	Qtz-Scl-Apy (Au-Py-Cp-Sp-Gn)	MacKenzie and Craw (1993); Pitcairn *et al.* (2006)
The Ovens *(D)*	NS, Canada	Au	EDEV (407 ± 4 Ma)		Turbidite-hosted	Slates and metaSs	n.d.	Vein Selvages (carbonic)	Qtz-Cal-Chl-Ab-Ms (Tur-Scl-Po-Py-Apy-Cp-Gn-Mlb-Au)	Sangster and Smith (2007); Kontak *et al.* (2011)
Moose River *(D)*	NS, Canada	Au (W-Pt)	EDEV (408 – 380 Ma)		Turbidite-hosted	Qzt, Arg, slate	Gr-Grd	Sericitic, carbonic, silicic	Qtz-Ank-Cal-Dol-Chl-Bt-Ms-Scl (Apy-Po-Cp-Gn-Mlb-Au)	Mulligan (1984); Hudgins (1996); Sangster and Smith (2007)
Jardine *(D)*	Montana, USA	Au (As-W)	ARCH*		Turbidite-hosted?	Metaturbidite (metapelite, BIF)	Qtz-Mz	Silicic	Qtz-Hbl-Grt-Bt-Apy-Po-Cp (Gn-Au-Scl)	Fraser *et al.* (1969); Smith (1996)
Hollinger *(D)*	ON, Canada	Au (W)	LARCH* (2617 ± 15 Ma)		Greenstone-hosted?	Tholeiitic basalts, Carb	Grd	Vein selvage (Fe-carbonic, sericitic)	Qtz-Scl-Ank-Py-Ab-Tur (Au-Ap-Cp-Sp-Gn-Po)	Allen and Folinsbee (1944); Jones (1948); Wood (1991)
Sigma *(D)*	QC, Canada	Au	ARCH		Greenstone-hosted	Calc-alkalic tuffs, tholeiilitc basalts	D	Vein selvage (carbonic, sericitic)	Qtz-Tur-Cal-Ms-Chl (Py-Scl-Cp-Au)	Robert and Brown (1986a,b); Olivo *et al.* (2006)
Morro Velho *(D)*	Brazil	Au	LARCH (2672 ± 14 Ma)		Greenstone-hosted	Fe-Dol (slate, metavolcanics)	Tonalite-Grd	Carbonic, sericitic, chloritic, silicic	Qtz-Dol-Sd-Cal-Ms-Chl-Ab (Ep-Rt-Ap-Ilm-Mgt-Py-Tur-Scl)	Bernasconi (1985); Lobato *et al.* (2007); Vial *et al.* (2007)
Delnite *(D)*	ON, Canada	Au-Ag	ARCH		Greenstone-hosted	Komatiites, tholeiitic basalts	n.d.	Carbonic	Qtz-Cal-Apy-Py-Tur (Au-Scl)	Taylor (1948); Ferguson *et al.* (1971)
Little Long Lac *(D)*	ON, Canada	Au-Ag (W)	ARCH*		Greenstone-hosted?	Felds-Qzt	D	Vein selvage (Silicic, sericitic)	Qtz-Apy-Cp-Tur (Gn-Au-Scl-Po)	Bruce and Samuel (1937); Horwood (1948a); Ferguson *et al.* (1971)
Crane *(O)*	ON, Canada	W (Au-Mo)	LARCH (2680 Ma)		Greenstone-hosted?	Cgl-schist, Bt-Chl-schist	Grd	n.d.	Qtz-Scl-Mlb-Py (Ms-Pl-Cal-Au)	McCartney (1943); Nickel (1952)
Mackenzie Mine *(D)*	ON, Canada	Au-Ag	LARCH* (2720 ± 3 Ma)		Greenstone-hosted	Mylonite-D	D / Qtz-D	Carbonic, silicic, sericitic	Qtz-Cal-Ms-Tur-Py-Apy-Ank (Au-Scl-Cp-Gn-Sp)	Horwood (1948b); Ferguson *et al.* (1971); Dubé (2004)
Zinnwald – Cínovec *(D)*	Czech Republic	Sn-W-Li	ECARB – DEV* (330 – 395 Ma)	Magmatic	Greisen	Greisens, Gnt	Gr	Greisen	Qtz-Cst-Znw-Wf-Scl-Sd-Cal-Toz-Ms-Fl	Durisoval *et al.* (1979); Štemprok (1986); Webster *et al.* (2004)
Carrock Fell *(D)*	United Kingdom	W (Mo)	MDEV (386 ± 6 Ma)		Greisen	Gnt, gabbro, slate (Hfls?)	Gr	Qtz-Ms-Ap	Qtz-Ms-Ap-Wf-Scl (Py-Apy-Po-Fl-Dol-Cal)	Appleton and Wadge (1976); Shepherd and Waters (1984); Ball *et al.* (1985)
RocherDéboulé*(D)*	B.C., Canada	Cu-Ag (Au-W)	LCRET*		Greisen	D, Qzt, Mdst, Sltst	Grd / D	Vein selvage (phyllic, sericitic)	Hlb-Qtz (Pl-Ap-Mgt-Scl-Tur-Fbr-Mlb)	Sutherland Brown (1960); Burgonyne and Kikauka (2007)
DaeHwa (Taewha) *(D)*	South Korea	W-Mo	LCRET (82 ± 2 Ma)		Porphyry-related	Bt-Gr-gneiss	Gr	Contact aureole (sericitic, chloritic)	Qtz-Ms-Brl-Mlb-Cst-Wf-Scl-Fl (Py-Po-Cp)	Bancroft (1979); So *et al.* (1983); Sheldon *et al.* (1987)
Sisson W-Mo Deposit *(D)*	NB, Canada	W-Cu-Mo	LDEV* (379 Ma)		Porphyry-related	Meta-gabbro / volcanics / Seds	Gr	Potassic, sericitic, chloritic	Qtz-Scl-Mlb-Hbl-Bt-Mgt-Ab-Po (Wf-Py-Cp)	Nast and William-Jones (1991); Bustard *et al.* (2013)
Yongwol (Yeongwol-gun) *(D)*	South Korea	W-Mo	LCRET*		Porphyry-related?	Shl, Ls	Mz	Potassic, silicic	Qtz-Dol-Scl-Mlb-Py-Wf-Di-Grt-Hbl-Fl-Ap	Laznicka (2006)
Kalzas (Flo Property) *(O)*	YT, Canada	W (Sn)	LCRET* (90 – 95 Ma)		Porphyry-related	Clastic metaSeds	Gr	Zoned (potassic, Qtz-Tur-Ms, Qtz-Ms-Py)	Qtz-Tur-Wf-Py-Ms-Cst (Or-Ap-Mlb-Scl-Apy)	Lynch (1989); Carlson (2002)
Dublin Gulch (Eagle Zone?) *(D)*	YT, Canada	Au (W)	LCRET* (92.8 ± 0.5 Ma)		Porphyry-related	Qzt, Phy, schist (Carb)	Bt-Grd	Contact aureole (Bt-Qtz, sericitic, chloritic)	Qtz-Kfs-Ab-Cal-Ms-Chl-Scl-Po-Apy-Py	Sinclair (1986); Brown *et al.* (2002); Maloof *et al.* (2001)

Table 3.1. *(Continued)*

Deposit[1]	Country	Commodity[2]	Age of Mineralization[3]		Type of Mineralization	Host Rock(s)	Intrusion Type	Alteration	Principal Mineral Assemblages[4]	References
Hermosillo *(D)*	Mexico	W	PALEO*	Magmatic	Skarn?	Ls, Shl	Grd	n.d.	Qtz-Cal-Grt-Ep-Scl	Mead *et al.*(1988)
Guadalupana *(O)*	Sonora, Mexico	Ag-Au	EO?		Skarn?	Rhy, And, Tuff, Shl	n.d.	n.d.	Qtz-Ves-Tur-Ep-Scl-Ap-Pwl-Ttn	Trask and Cabo (1948); Panczner (1987); Clark and Fitch (2009)
Sangdong *(D)*	South Korea	W-Mo (Bi-Au)	LCRET (84 ± 3 Ma)		Skarn	Ls (Hfls, Ss, Shl)	Gr	Zoned (Qtz-Ms, Amp, Px-Grt)	Qtz-Bt-Ms-Scl (Hbl-Grt-Di-Wf-Mlb-Fl)	Farrar *et al.*(1978); Laznicka (2006)
Traversella *(D)*	Italy	Cu-Fe (W)	OLIGO* (30 ± 5 Ma)		Skarn	Gneiss, eclogitic mica schists, Dol	Mz-D	Zoned (Grt, Px, Cal)	Cal-Dol-Scl-Mgt-Cp-Fo-Px-Chl-Wo-Di	Dubru *et al.* (1988); Vander Auwera and Andre (1991); Vander Auwera and Verkaeren (1993)
San Alberto *(D)*	Mexico	W (Cu)	PALEO (56.4 Ma)		Skarn	Ls	Qtz-Mzd	Contract aureole (silicic, propylitic, argillic)	Qtz-Cal-Grt-Amp-Scl-Ep	Anstett *et al.* (1985); Mead *et al.* (1988)
Cantung *(D)*	NWT, Canada	W	LCRET (91.4 Ma)		Skarn	Ls (Arg, Qzt, Hfls, Mrb)	Bt-Gr	Contact aureole (Grt, Px)	Scl-Po-Cp-Di-Px-Qtz-Amp (Cal-Tur-Ap)	Mathieson and Clark (1984); Laznicka (2006)
Kumbel (Kara-Urkurt) *(D)*	Kyrgyzstan	W-Cu-Mo (Au)	CARB* (≈ 310 – 312 Ma)		Skarn	Ls, Ss	Mz / Mzd	Propylitic, phyllic	Qtz-Cal-Amp-Px-Cal-Grt-Scl-Cp-Ves-Hem-Mgt-Py-Mlb-Brl-Ap	Rabchevsky (1988); Soloviev (1994, 2015)
Sanford *(O)*	Maine, USA	Mo-W	CARB* (322 ± 12 Ma)		Skarn	Gfls (Mrb)	Bt-Gr	n.d.	Ves-Fl-Sp-Cal-Di-Grt-Qtz (Mlb-Scl-Pwl-Ttn)	Leavitt and Leavitt (1993)
Tungstar *(D)*	California, USA	W (Si)	CRET*		Skarn	Ls, Hfls, Qtz-D	Qtz-D	n.d.	Grt-Ep-Qtz-Py-Ap-Ttn-Scl	Lemmon (1941); Bateman (1953)
Emerald *(D)*	BC, Canada	W-Mo (Au-Pb-Zn)	CRET		Skarn	Ls, Arg (Shl?)	Gr	Sericitic, chloritic, silicic	Px-Grt-Amp (Bt-Ep-Pl-Ves-Scl-Pwl-Wf-Mlb-Po-Py-Cp)	Ball (1954); Mulligan (1984); Cathro and Lefebure (2000)
Flat River (M.B. Prospect) *(O)*	NWT, Canada	W	LCRET* (90 – 92 Ma)		Skarn?	Ls, Arg	Qtz-Mz	Retrograde (Hbl-Bt)	Px-Grt-Ves-Scl-Chl-Qtz-Cal (Wo-Cp)	Blusson (1968); Mulligan (1984); Burt (1986)
Tulare *(O)*	California, USA	W	LCRET*		Skarn?	Dol, Ls	Grd	Contact aureole	Grt-Qtz-Scl (Cal-Py-Mlb-Pwl)	Krauskopf (1953)
Ortiz Mine (Cunningham Hill) *(D)*	New Mexico, USA	Au-Ag (W-Cu)	OLIGO (≈ 28 Ma)		Breccia?	Bx (Qzt, Ss, Shl)	Mz / Mzd	n.d.	Qtz-Py-Mgt-Cal-Sd-Cp-Au-Scl	Maynard (1995)
Castañeda de Llamuco Mine *(D)*	Chile	Cu (W)	CRET*		Breccia?	And	Gr	Potassic, sericitic, argillic, silicic, propylitic	Qtz-Ms-Scl-Apy-Tur-Py-Cal (Cp-Gn-Wf)	McAllister and Ruiz F. (1948); Sillitoe (1973)
A.M. Berges W-Prospect *(O)*	Mexico	Ag (Pb-Zn-Au)	MIO*	Hydrothermal	Polymetallic?	Ss (Shl, Sltst, Carb)	Gr / Grd	n.d.	Qtz-Cal-Py-Sp-Gn-Cp	Lopez *et al.* (2012)
Silverton (Sunnyside Mine?) *(D)*	Colorado, USA	Zn-Pb-Cu (Ag-Au)	MIO (13 – 16.6 Ma)		Polymetallic	Qtz-latite, Seds, Bx	Qtz-Mz	Phyllic, sericitic, propylitic	Qtz-Sph-Gn-Py-Rds-Cp-Td-Fl-Cal	Rosenzweig (1957); Casadevall and Ohmoto (1977); Eberl *et al.* (1987)
Kovárna Mine (Obří dul, Riesengrund) *(D)*	Czechoslovakia	Fe-As-Cu (W)	CARB* (304 – 329 Ma)		Polymetallic?	Schist, Qzt, Ls	Bt-Grd	Contact aureole (sericitic)	Qtz-Cal-Po-Fl-Cp-Asp-Mgt (Scl-Py-Gn-Sp-Mlb-Cst-Rt)	Štemprok (1986); Žák, J. and Klomínský (2007); Žák, J. *et al.* (2008)
Britannia Mine *(D)*	BC, Canada	Cu-Zn-Pb (Ag-Cd-Au)	CRET*		VMS	Chl-Ms-schist, slate	Qtz-D / Qtz-Mzd	Chloritic, sericitic	Qtz-Py-Ms-Chl-Cp-Sph (Anh-Gn-Tn-Td)	Schofield (1926); Irvine (1948); Payne *et al.* (1980)

[1] Alternative names in ( ); *(D)* Denotes deposit and occurrence *(O)*.
[2] Metals and minerals are generally listed in approximate decreasing order of abundance (some may be sub-equal in abundance); metals and minerals in parentheses are minor; paragenetic sequences have been combined for simplicity.
[3] In some instances the age of mineralization is related to the age of associated magmatism*.
[4] Abbreviations are those recommended by Kretz (1983) and Spear (1993). In cases of districts, not all minerals may be present in a given deposit; n.d. = no data.

Samples were divided into three groups based on inferred geologic processes: (1) metamorphic; (2) magmatic hydrothermal; and (3) hydrothermal (i.e., lacking obvious magmatic or metamorphic affiliation). Within each group, subdivisions are possible. For example, the deposits related to metamorphic processes include: (i) turbidite-hosted Au ± W deposits and (ii) greenstone-hosted Au deposits. Deposits related to magmatic-hydrothermal processes include: (i) greisen, (ii) porphyry-related, and (iii) skarn. Lastly, deposit types in the hydrothermal group include: (i) breccia-type, (ii) polymetallic vein-type, and (iii) VMS.

3.3. Analytical techniques

Scheelite grains studied were prepared for analysis in one of two ways. Small grains (<10 mm) were made into epoxy grain-mounts, whereas polished thick sections (≈ 65 μm) were used for large grains (>10 mm). Prior to geochemical analysis, the mounted scheelite and polished thick sections were studied using CL to determine the extent and type of zoning present (Poulin *et al.* 2016).

3.3.1. Oxygen isotope analysis

The $\delta^{18}O$ values of 31 scheelite grains from 23 deposits were determined on high-purity separates produced by hand-picking millimetre-sized grains from lightly crushed material using a binocular microscope with a UV lamp for illumination. The separates were then hand-pulverised using a porcelain mortar and pestle to produce a fine powder, which was then analysed at the Queens's University Stable Isotopic Facilities, Kingston, Ontario, Canada using the BrF_5 method (Clayton & Mayeda 1963). Isotope measurements were performed using a Finnigan MAT 252 mass spectrometer and all values are reported in the standard δ notation, relative to Vienna standard mean ocean water (V-SMOW). The reproducibility (2σ) of $\delta^{18}O$ values are ± 0.2 ‰, based on replicate analyses of laboratory standards.

3.3.2. Laser ablation ICP-MS

Major, minor, and trace element compositions and distribution in scheelite were determined using LA-ICP-MS in both the point and rastering modes. The elements analysed were Li, B, Na, K, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Mo, Ag, Sn, Ba and the rare earth elements (REE). Analyses were performed at Laurentian University with a Thermo X SERIES II quadrupole ICP-MS in a two-volume Laurin Technic sample cell using a pulsed ArF excimer laser (RESOlution M-50) emitting at 193 nm and a repetition rate of 10 Hz. All analyses were made using a ~ 47 µm beam size. The instrument operated with a forward power of 1450 W. Gas flows were 800 ml/min for argon, 650 ml/min for He and 6 ml/min for N. Acquisition times for most masses were set to 10 ms, but the major elements in scheelite (Ca, W) were measured for 5 ms and trace elements (Y + REE) for 15 ms. Data were processed using Iolite (Paton *et al.* 2011) using Ca^{44} as the internal standard and assuming a stoichiometric chemistry for scheelite (i.e., $CaWO_4$). The precision of trace element analysis by LA-ICP-MS is rarely better than 5 percent (Danushevsky *et al.* 2009), so variations less than this are considered to be within the error of the instrumentation. The Ca concentration in scheelite normally varies by less than 5 percent of its stoichiometric value (e.g., as reflected in the data of Song *et al.* 2014). External calibration was made against the standard glasses NIST 612 and BHOV 2G using the concentrations given in Pearce *et al.* (1997) to correct for variations in ablation yield and response intensity during analysis.

3.4. Results

3.4.1. Oxygen isotope data

The scheelite $\delta^{18}O$ data are presented in Table 3.2 and are subdivided into deposit type in Table 3.3 where it is seen that there is no obvious correlation of results with deposit setting. Overall the $\delta^{18}O$ values range from -4.6 to +12.7‰ and are centred on +5‰. In addition, the $\delta^{18}O$ values in any given ore deposit type are quite variable: for example, the ^{18}O values of scheelite from porphyry-related systems range from -0.5 to +9.1‰. Duplicate and triplicate analyses for deposits were done to assess variability and whereas for several (The Ovens, Moose River, Hollinger, Sigma, and Traversella) the range was between 0.9 and 2.0‰, for Sisson and Britannia it was much larger at 5.5‰ and 6.3‰, respectively; these ranges are well outside of that expected based on analytical reproducibility (i.e., ± 0.2‰).

There are two scheelite-H_2O fractionation equations available (Wesolowski & Ohmoto 1986; Zheng 1992) and both were used to calculate the $\delta^{18}O_{H2O}$ values for fluids in isotopic equilibrium with scheelite at selected temperatures (Table 3.2). The results are summarized on plots of $\delta^{18}O_{H2O}$ values for temperature of limiting temperatures of 400°C and 200°C (Fig. 3.1) and in a plot of $\delta^{18}O_{Scheelite}$ *versus* temperature contoured with values of $\delta^{18}O_{H2O}$ (Fig. 3.2). In both of these diagrams, the range in $\delta^{18}O_{H2O}$ for different fluid types is shown, but the implications of this are discussed later.

3.4.2. Trace element data

Approximately 700 major and trace element analyses were performed on 36 scheelite grains from a diverse collection of global deposit sites that represent different ore deposit settings. As noted above, these sites are subdivided in three general categories - metamorphic, magmatic, and hydrothermal (Table 3.4). Of the 35 elements analysed, those exhibiting the

Table 3.2. Summary of oxygen isotope data for scheelite samples.

Deposit*		Type of Mineralization	$\delta^{18}O_{Scheelite}$ (in ‰$_{V\text{-}SMOW}$)	$\delta^{18}O_{H2O}$ (‰) 600°C	$\delta^{18}O_{H2O}$ (‰) 500°C	$\delta^{18}O_{H2O}$ (‰) 450°C	$\delta^{18}O_{H2O}$ (‰) 400°C	$\delta^{18}O_{H2O}$ (‰) 350°C	$\delta^{18}O_{H2O}$ (‰) 300°C	$\delta^{18}O_{H2O}$ (‰) 250°C	$\delta^{18}O_{H2O}$ (‰) 200°C	$\delta^{18}O_{H2O}$ (‰) 150°C
Barewood	Metamorphic	Turbidite-hosted	4.7	7.2	6.9	6.7	6.3	5.7	4.9	3.7	2	-0.5
Macraes, NZ[1]		*Turbidite-hosted*	*4.8*	*7.3*	*7*	*6.8*	*6.4*	*5.8*	*5*	*3.8*	*2.1*	*-0.4*
The Ovens		Turbidite-hosted	4.9	7.4	7.1	6.9	6.5	5.9	5.1	3.9	2.2	-0.3
The Ovens		Turbidite-hosted	6.8	9.3	9	8.8	8.4	7.8	7	5.8	4.1	1.6
Moose River		Turbidite-hosted	6.9	9.4	9.1	8.9	8.5	7.9	7.1	5.9	4.2	1.7
Moose River		Turbidite-hosted	8.8	11.3	11	10.8	10.4	9.8	9	7.8	6.1	3.6
Björkdal, Sweden[4]		*Greenstone-hosted?*	*3.3*	*5.8*	*5.5*	*5.3*	*4.9*	*4.3*	*3.5*	*2.3*	*0.6*	*-1.9*
Hollinger[5]		*Greenstone-hosted?*	*3.4*	*5.9*	*5.6*	*5.4*	*5*	*4.4*	*3.6*	*2.4*	*0.7*	*-1.8*
Hollinger		Greenstone-hosted?	4.9	7.4	7.1	6.9	6.5	5.9	5.1	3.9	2.2	-0.3
Sigma		Greenstone-hosted	4.2	6.7	6.4	6.2	5.8	5.2	4.4	3.2	1.5	-1
Sigma		Greenstone-hosted	4.5	7	6.7	6.5	6.1	5.5	4.7	3.5	1.8	-0.7
Sigma		Greenstone-hosted	5.6	8.1	7.8	7.6	7.2	6.6	5.8	4.6	2.9	0.4
Morro Velho		Greenstone-hosted	6.8	9.3	9	8.8	8.4	7.8	7	5.8	4.1	1.6
Delnite		Greenstone-hosted	7.2	9.7	9.4	9.2	8.8	8.2	7.4	6.2	4.5	2
Zinnwald – Cínovec	Magmatic	Greisen	3.6	6.1	5.8	5.6	5.2	4.6	3.8	2.6	0.9	-1.6
Zinnwald – Cínovec		Greisen	4.6	7.1	6.8	6.6	6.2	5.6	4.8	3.6	1.9	-0.6
Carrock Fell		Greisen	4.6	7.1	6.8	6.6	6.2	5.6	4.8	3.6	1.9	-0.6
RocherDéboulé		Greisen	5.2	7.7	7.4	7.2	6.8	6.2	5.4	4.2	2.5	0
W-Sn vein, Ireland[3]		*Greisen*	*6.4*	*8.9*	*8.6*	*8.4*	*8*	*7.4*	*6.6*	*5.4*	*3.7*	*1.2*
DaeHwa, South Korea[6]		*Porphyry-related*	*-0.5*	*2*	*1.7*	*1.5*	*1.1*	*0.5*	*-0.3*	*-1.5*	*-3.2*	*-5.7*
Sisson W-Mo Deposit		Porphyry-related	1.3	3.8	3.5	3.3	2.9	2.3	1.5	0.3	-1.4	-3.9
Sisson W-Mo Deposit		Porphyry-related	6.8	9.3	9	8.8	8.4	7.8	7	5.8	4.1	1.6
Yongwol		Porphyry-related?	4.5	7	6.7	6.5	6.1	5.5	4.7	3.5	1.8	-0.7
Dublin Gulch		Porphyry-related	9.1	11.6	11.3	11.1	10.7	10.1	9.3	8.1	6.4	3.9
Hermosillo		Skarn?	3.3	5.8	5.5	5.3	4.9	4.3	3.5	2.3	0.6	-1.9
Guadalupana		Skarn?	3.3	5.8	5.5	5.3	4.9	4.3	3.5	2.3	0.6	-1.9
Sangdong		Skarn	3.8	6.3	6	5.8	5.4	4.8	4	2.8	1.1	-1.4
Traversella, Italy[7]		*Skarn*	*3.3*	*5.8*	*5.5*	*5.3*	*4.9*	*4.3*	*3.5*	*2.3*	*0.6*	*-1.9*
Traversella		Skarn	5.9	8.4	8.1	7.9	7.5	6.9	6.1	4.9	3.2	0.7
Traversella		Skarn	6.8	9.3	9	8.8	8.4	7.8	7	5.8	4.1	1.6
San Alberto		Skarn	5.3	7.8	7.5	7.3	6.9	6.3	5.5	4.3	2.6	0.1
Cantung, NWT[8]		*Skarn*	*6.9*	*9.4*	*9.1*	*8.9*	*8.5*	*7.9*	*7.1*	*5.9*	*4.2*	*1.7*
Kumbel		Skarn	8.4	10.9	10.6	10.4	10	9.4	8.6	7.4	5.7	3.2
Ortiz Mine	Hydrothermal	Breccia?	3.2	5.7	5.4	5.2	4.8	4.2	3.4	2.2	0.5	-2
A.M. Berges W-Prospect		Polymetallic?	3.6	6.1	5.8	5.6	5.2	4.6	3.8	2.6	0.9	-1.6
Silverton		Polymetallic	5.4	7.9	7.6	7.4	7	6.4	5.6	4.4	2.7	0.2
Huya, South Korea[2]		*Polymetallic?*	*12.7*	*15.2*	*14.9*	*14.7*	*14.3*	*13.7*	*12.9*	*11.7*	*10*	*7.5*
Britannia		VMS	-4.6	-2.1	-2.4	-2.6	-3	-3.6	-4.4	-5.6	-7.3	-9.8
Britannia		VMS	1.7	4.2	3.9	3.7	3.3	2.7	1.9	0.7	-1	-3.5

*Italicized data are averages from referenced sources (in superscript): [1]de Ronde *et al.* (2000), [2]Cao *et al.* (2002), [3]Gallagher (1989), [4]Broman *et al.* (1994); Roberts *et al.* (2006), [5]Wood (1991), [6]Shelton *et al.* (1987), [7] Vander Auwera and Andre (1991) and [8]Yuvan (2006). δO^{18}_{H2O} values calculated using the fractionation equation of Zheng (1992).

Table 3.3. Summary of $\delta^{18}O$ data (in ‰$_{V\text{-}SMOW}$) for scheelite from different deposit types.

Classification	Deposit type	*n*	Min	Max	Average
Metamorphic	Turbidite-hosted	6	4.7	8.8	6.2
	Greenstone-hosted	8	3.3	7.2	5.0
Magmatic	Greisen	5	3.6	6.4	4.9
	Porphyry-related	5	-0.5	9.1	4.2
	Skarn	9	3.3	8.4	5.2
Hydrothermal	Breccia	1	3.2	3.2	3.2
	Polymetallic	3	3.6	12.7	7.2
	VMS	2	-4.6	1.7	-1.5

greatest variation were (maximum values indicated in each case): Mo (160 000 ppm), Sr (11 480 ppm), ΣREE+Y (5306 ppm), As (2320 ppm), and Mn (161 ppm). The remaining elements had concentrations at or below their respective detection limits and are therefore not considered as important components of scheelite. Compositional variations between scheelite settings typically do not exceed two orders of magnitude.

Various element concentrations for scheelites are shown in log plots for Mo, Sr, As, Mn, ΣREE+Y, and Eu anomaly ($Eu_A = (Eu/Eu_N)/Eu^*$, *wheras* $Eu^* = 0.5(Sm/Sm_N) + 0.5(Gd/Gd_N)$; Guion *et al.* 1985) (Figs. 3.3 to 3.8, respectively) in order to illustrate compositional variations among scheelites from the three main geologic settings, whereas chondrite-normalized REE patterns (CN-REE) for individual scheelites within each group are summarized in Figures 3.9 to 3.11 using normalizing factors of Sun & McDonough (1989). Note that in these figures, both the range and average (bold black lines) values are shown and samples are since data were collected for both multiple samples from a site and also fragments of single samples from a site.

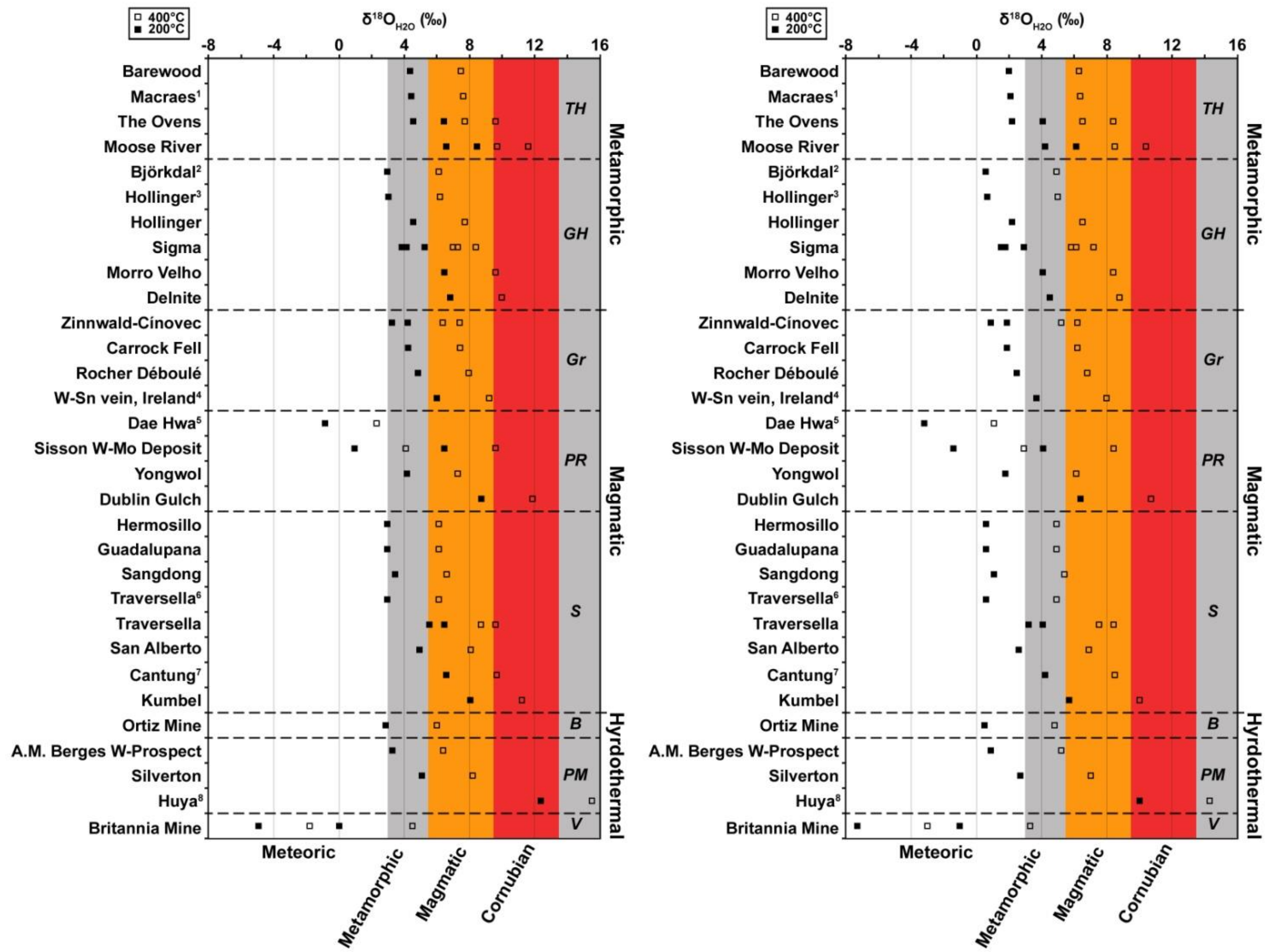

Figure 3.1. A summary of the calculated $\delta^{18}O_{H2O}$ values for fluids in equilibrium with scheelite precipitating at temperatures of 200°C and 400°C using the fractionation equations of Wesolowski and Ohmoto (1986; left) and Zheng (1992; right). Note that the data have been grouped by deposit and fluid type. The coloured boxes show the range in $\delta^{18}O_{H2O}$ for metamorphic fluids (grey box, + 3 to + 20‰), primary magmatic fluid (orange box, +5.5 to +9.5‰) and Cornubian fluids (red box, + 9.5 to + 13.2‰), as indicated by Sheppard (1986, 1977). The deposits are classified as follows in the diagram: TH - turbidite-hosted, GH - greenstone-hosted, Gr - greisen, PR - porphyry-related, S - skarn, B - breccia, PM - polymetallic and V - volcanogenic-massive sulphide.

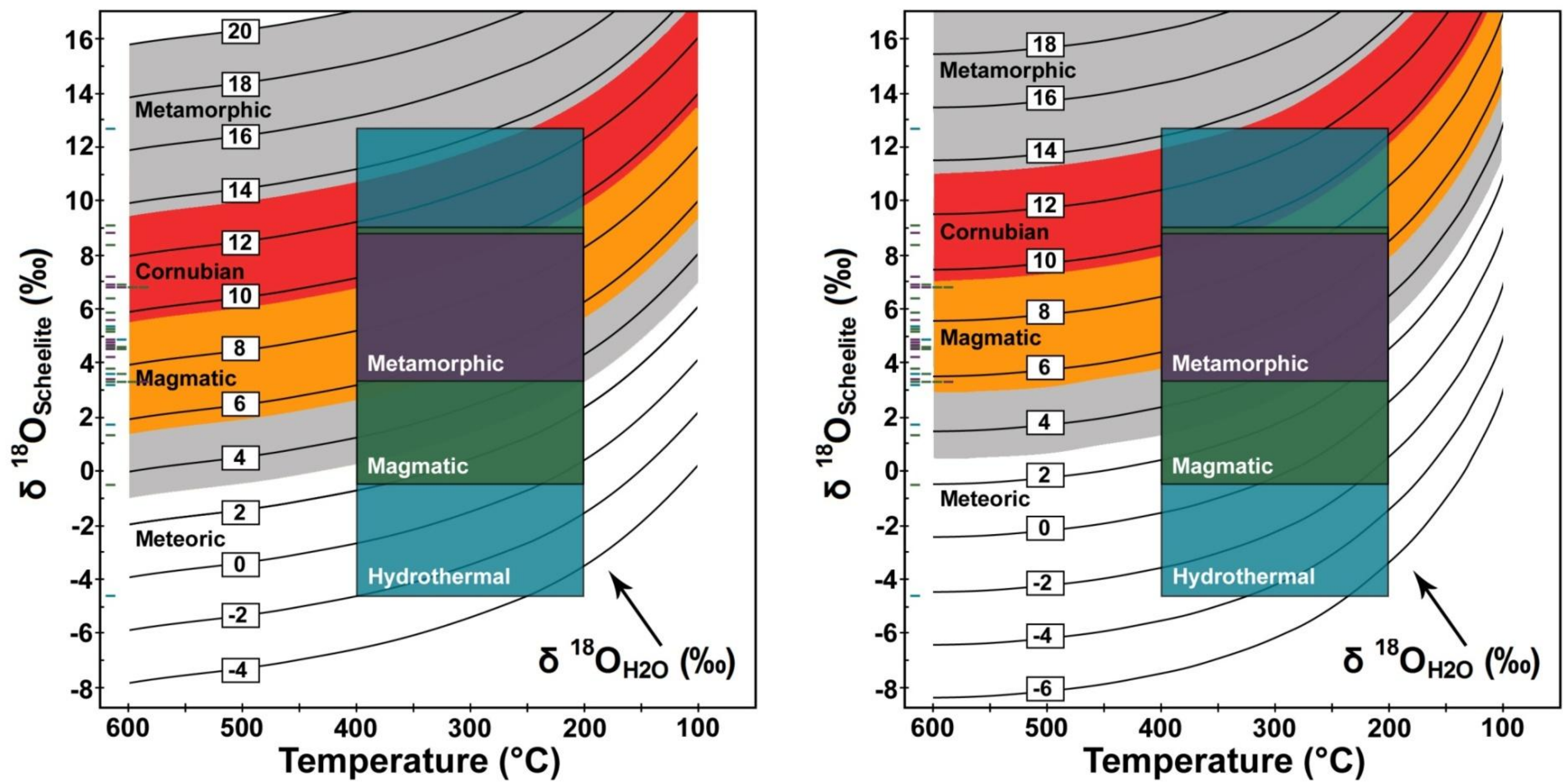

Figure 3.2. Plots of temperature (°C) *versus* $\delta^{18}O_{Scheelite}$ with isopleths of $\delta^{18}O_{H2O}$ as calculated using the scheelite-H_2O fractionation equations of Wesolowski and Ohmoto (1986; left) and Zheng (1992; right). The $\delta^{18}O$ scheelite data for the samples studied are shown as tick marks on the vertical axis whereas the shaded boxed indicate the inferred $\delta^{18}O_{H2O}$ values based on scheelite precipitation at 200° to 400°C. Note that the data have been grouped by deposit and fluid type. The coloured areas on the diagram show the range in $\delta^{18}O_{H2O}$ for metamorphic fluids (grey, + 3 to + 20‰), primary magmatic fluid (orange, +5.5 to +9.5‰) and Cornubian fluids (red, + 9.5 to + 13.2‰), as indicated by Sheppard (1986, 1977).

Table 3.4. Trace-element contents (ppm) in scheelite from different deposit types.

Deposit Type	Metamorphic (n = 149)				Magmatic (n = 398)			
Element	*Min*	*Max*	*Median*	*Mean[1]*	*Min*	*Max*	*Median*	*Mean[1]*
Li	≤ LOD	7 (0.3)	2	3 (0.2)	≤ LOD	25 (27.0)	4	5 (5.9)
B	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	143 (64.0)	29	35 (7.4)
Na	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	≤ LOD	n.d.	n.d.
K	≤ LOD	70 (25.0)	52	52 (16.0)	≤ LOD	220 (140.0)	45	65 (103.4)
Ti	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	43 (25.0)	7	9 (15.2)
V	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	7 (0.2)	4	4 (0.7)
Cr	≤ LOD	4 (0.3)	2	2 (0.4)	≤ LOD	28 (46.0)	4	6 (18.0)
Mn	≤ LOD	13.9 (4.1)	6.6	6.0 (0.5)	≤ LOD	118.4 (1.3)	16.7	27.9 (4.0)
Fe	≤ LOD	51 (17.0)	4	8 (5.1)	≤ LOD	650 (360.0)	17	74 (30.3)
Co	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	2.2 (0.9)	1.1	1.1 (1.0)
Ni	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	130 (100.0)	5	8 (12.0)
Cu	≤ LOD	2 (0.2)	2	2 (0.3)	≤ LOD	130 (100.0)	3	7 (7.2)
Zn	≤ LOD	2 (0.3)	2	2 (0.3)	≤ LOD	28 (19.0)	3	4 (3.6)
As	≤ LOD	160 (8.9)	4	9 (0.6)	≤ LOD	2320 (700.0)	28	312 (57.9)
Rb	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	2.5 (3.4)	0.9	1.1 (0.9)
Sr	198.8 (3.7)	11480.0 (330.0)	986.8	2232.4 (57.5)	14.3 (0.3)	7300.0 (1100.0)	131.2	386.9 (30.2)
Y	0.6 (0.0)	1270.0 (390.0)	112.1	209.8 (10.0)	≤ LOD	1575.0 (44.0)	51.8	218.7 (11.3)
Mo	≤ LOD	695 (21.0)	6	35 (0.8)	≤ LOD	67900 (8600.0)	5100	9239 (979.0)
Ag	≤ LOD	0.6 (0.1)	n.d.	n.d.	≤ LOD	0.9 (0.8)	n.d.	n.d.
Sn	≤ LOD	≤ LOD	n.d.	n.d.	≤ LOD	18.0 (16.0)	0.8	1.7 (1.9)
Ba	≤ LOD	7 (0.4)	2	3 (0.2)	≤ LOD	6 (2.7)	2	2 (2.7)
La	≤ LOD	50.2 (3.28)	10.1	12.4 (0.65)	≤ LOD	329.0 (14.00)	36.8	63.8 (3.54)
Ce	≤ LOD	166.1 (9.56)	27.4	39.1 (1.74)	≤ LOD	996.0 (32.00)	121.8	205.4 (9.99)
Pr	≤ LOD	41.8 (0.91)	4.0	7.0 (0.28)	≤ LOD	163.1 (5.10)	16.1	31.1 (1.51)
Nd	≤ LOD	315.1 (4.60)	25.3	42.5 (1.45)	≤ LOD	980.0 (30.00)	48.7	155.8 (7.24)
Sm	≤ LOD	219.3 (2.90)	15.5	25.0 (0.91)	≤ LOD	348.0 (11.00)	10.6	46.6 (2.56)
Eu	≤ LOD	155.51 (6.03)	33.76	35.78 (1.36)	≤ LOD	55.20 (1.30)	7.72	10.57 (0.44)
Gd	≤ LOD	354.3 (4.50)	17.0	39.6 (1.48)	≤ LOD	395.0 (12.00)	6.1	45.0 (2.48)
Tb	≤ LOD	53.7 (0.69)	4.4	8.6 (0.35)	≤ LOD	65.0 (2.10)	2.0	8.7 (0.51)
Dy	≤ LOD	375.0 (91.00)	21.3	53.6 (2.26)	≤ LOD	428.0 (15.00)	10.6	53.8 (3.19)
Ho	≤ LOD	67.0 (17.00)	5.1	11.3 (0.45)	≤ LOD	80.2 (2.20)	2.7	11.2 (0.73)
Er	≤ LOD	141.0 (39.00)	11.4	26.8 (1.11)	≤ LOD	207.4 (5.50)	9.7	31.0 (2.14)
Tm	≤ LOD	14.6 (4.40)	1.9	3.5 (0.17)	≤ LOD	29.1 (7.50)	2.3	5.1 (0.45)
Yb	≤ LOD	60.0 (20.00)	9.7	14.9 (0.93)	≤ LOD	165.0 (30.00)	22.7	34.7 (3.51)
Lu	≤ LOD	4.2 (0.08)	1.4	1.7 (0.10)	≤ LOD	17.5 (2.30)	4.7	5.4 (0.62)
ΣREE+Y	1.9 (0.1)	2442.2 (108.4)	346.2	507.4 (4.7)	0.8 (2.9)	5306.5 (44.7)	315.2	843.6 (15.1)
$(La/Lu)_{CN}$	0.07 (0.02)	13.94 (6.02)	1.63	2.46 (0.89)	n.d.	697.15 (1042.04)	1.26	11.25 (7.27)
$(La/Sm)_{CN}$	0.05 (0.03)	18.65 (8.46)	0.99	1.69 (0.61)	n.d.	65.22 (40.40)	1.15	4.50 (2.45)
$(La/Y)_{CN}$	0.02 (0.01)	4.94 (1.22)	1.29	1.28 (0.34)	n.d.	3565.09 (3185.19)	1.49	65.58 (47.88)
Eu_A = Eu/Eu*	0.59 (0.05)	489.74 (77.04)	4.65	15.70 (2.38)	n.d.	87.80 (14.75)	0.46	3.51 (0.65)
Ce_A = Ce/Ce*	0.44 (0.05)	1.19 (0.06)	0.92	0.92 (0.08)	n.d.	1.73 (1.20)	1.04	1.00 (0.31)

[1] The means were calculated using data above limit of limit of detection (LOD).

(Continued on next page)

Table 3.4. *(Continued)*

Deposit Type	Hydrothermal (n = 144)				LOD[1]
Element	*Min*	*Max*	*Median*	*Mean*[1]	
Li	≤ LOD	24 (49.0)	7	8 (11.4)	1
B	≤ LOD	54 (6.4)	29	33 (4.9)	15
Na	≤ LOD	≤ LOD	n.d.	n.d.	1554
K	≤ LOD	340 (210.0)	80	104 (117.5)	25
Ti	≤ LOD	28 (43.0)	6	9 (17.1)	2
V	≤ LOD	8 (1.8)	5	5 (2.5)	1
Cr	≤ LOD	9 (41.0)	5	5 (21.7)	1
Mn	≤ LOD	161.0 (88.0)	5.7	15.0 (4.9)	0.9
Fe	≤ LOD	330 (190.0)	40	75 (77.4)	2
Co	≤ LOD	3.8 (1.4)	1.3	1.6 (1.1)	0.8
Ni	≤ LOD	11 (8.4)	4	5 (9.0)	1
Cu	≤ LOD	800 (1000.0)	6	64 (59.6)	2
Zn	≤ LOD	22 (16.0)	3	4 (4.5)	2
As	≤ LOD	720 (440.0)	37	76 (13.9)	1
Rb	≤ LOD	4.9 (3.0)	0.9	1.4 (1.6)	0.6
Sr	35.2 (0.7)	5200.0 (1600.0)	205.0	647.3 (107.0)	0.5
Y	≤ LOD	918.0 (16.0)	128.6	174.1 (8.2)	0.5
Mo	4 (0.2)	160000 (97000.0)	3975	14255 (3216.6)	1
Ag	≤ LOD	68.0 (32.0)	11.2	24.7 (16.3)	1
Sn	≤ LOD	1.7 (2.4)	0.6	0.8 (1.0)	0.4
Ba	≤ LOD	2 (2.5)	2	2 (2.5)	1
La	≤ LOD	118.0 (22.00)	14.7	25.6 (1.34)	0.2
Ce	≤ LOD	319.0 (71.00)	52.1	79.4 (4.33)	1.3
Pr	≤ LOD	51.0 (0.52)	12.2	13.0 (0.71)	0.1
Nd	≤ LOD	336.1 (5.60)	41.9	73.2 (3.68)	0.5
Sm	≤ LOD	182.5 (3.60)	22.4	34.5 (1.85)	0.5
Eu	≤ LOD	46.60 (4.50)	4.39	10.17 (0.64)	0.09
Gd	≤ LOD	253.6 (5.20)	15.3	42.4 (2.34)	0.2
Tb	≤ LOD	37.4 (0.73)	7.1	8.8 (0.49)	0.2
Dy	≤ LOD	232.3 (4.10)	39.9	47.1 (2.42)	0.4
Ho	≤ LOD	43.8 (0.87)	10.4	12.1 (0.59)	0.2
Er	≤ LOD	111.5 (2.00)	31.1	31.6 (1.48)	0.3
Tm	≤ LOD	12.6 (0.21)	3.7	4.8 (0.22)	0.3
Yb	≤ LOD	83.9 (0.89)	18.5	27.2 (1.05)	0.3
Lu	≤ LOD	11.2 (0.12)	3.1	4.3 (0.20)	0.5
ΣREE+Y	0.3 (3.0)	2444.7 (10.2)	184.6	407.2 (7.4)	
$(La/Lu)_{CN}$	0.22 (0.13)	331.41 (122.15)	1.30	17.41 (7.08)	
$(La/Sm)_{CN}$	0.08 (0.05)	73.52 (26.88)	2.68	6.46 (3.63)	
$(La/Y)_{CN}$	n.d.	1454.62 (991.62)	4.57	88.11 (74.05)	
$Eu_A = Eu/Eu^*$	n.d.	156.68 (126.39)	1.34	4.31 (1.85)	
$Ce_A = Ce/Ce^*$	0.43 (0.31)	2.14 (1.77)	0.95	0.93 (0.33)	

[1] The means were calculated using data above limit of limit of detection (LOD);
[2] The LOD was calculated from repeated measurements of NIST 612;
n.d. not determined.

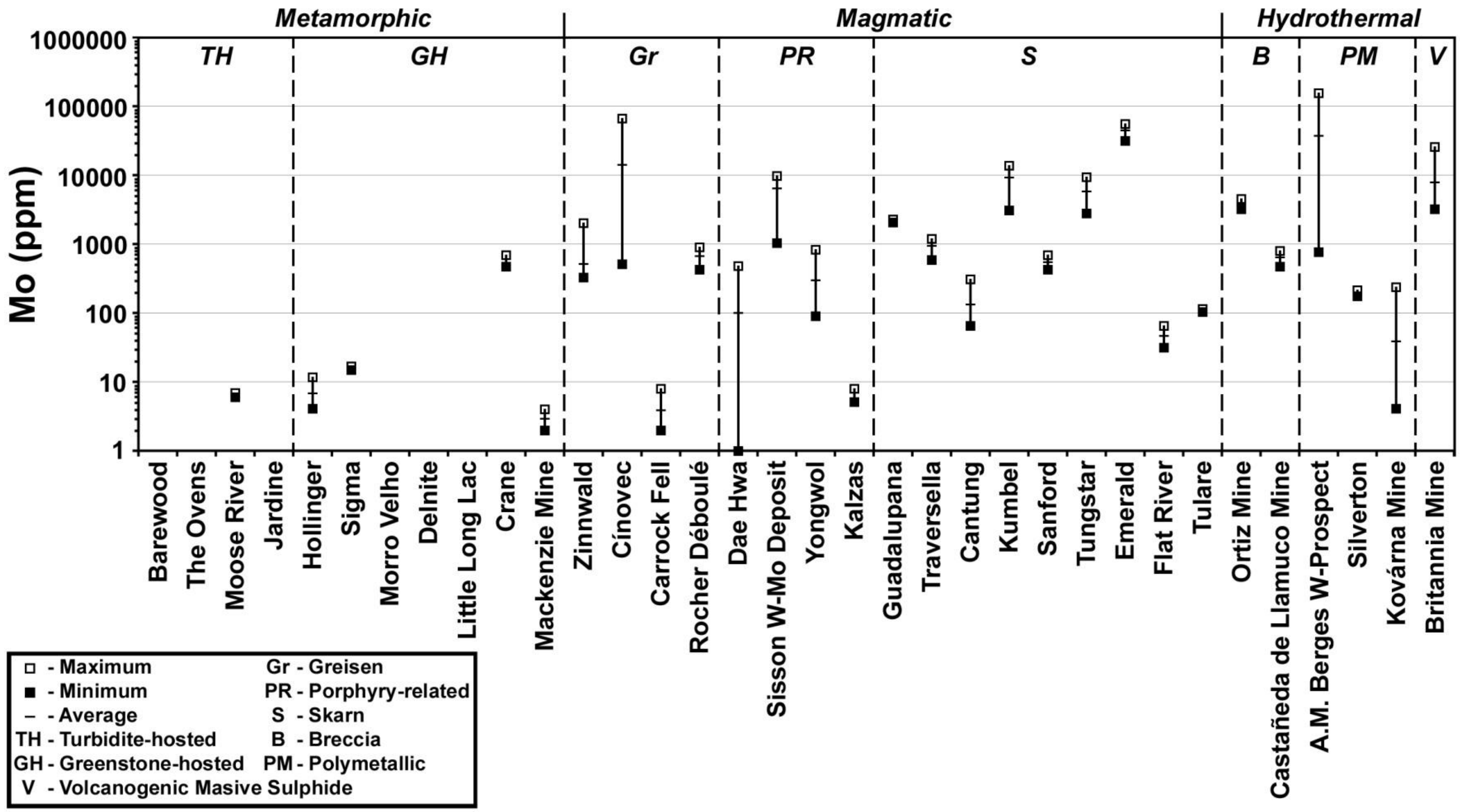

Figure 3.3. A plot summarizing the Mo concentrations (log scale) in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

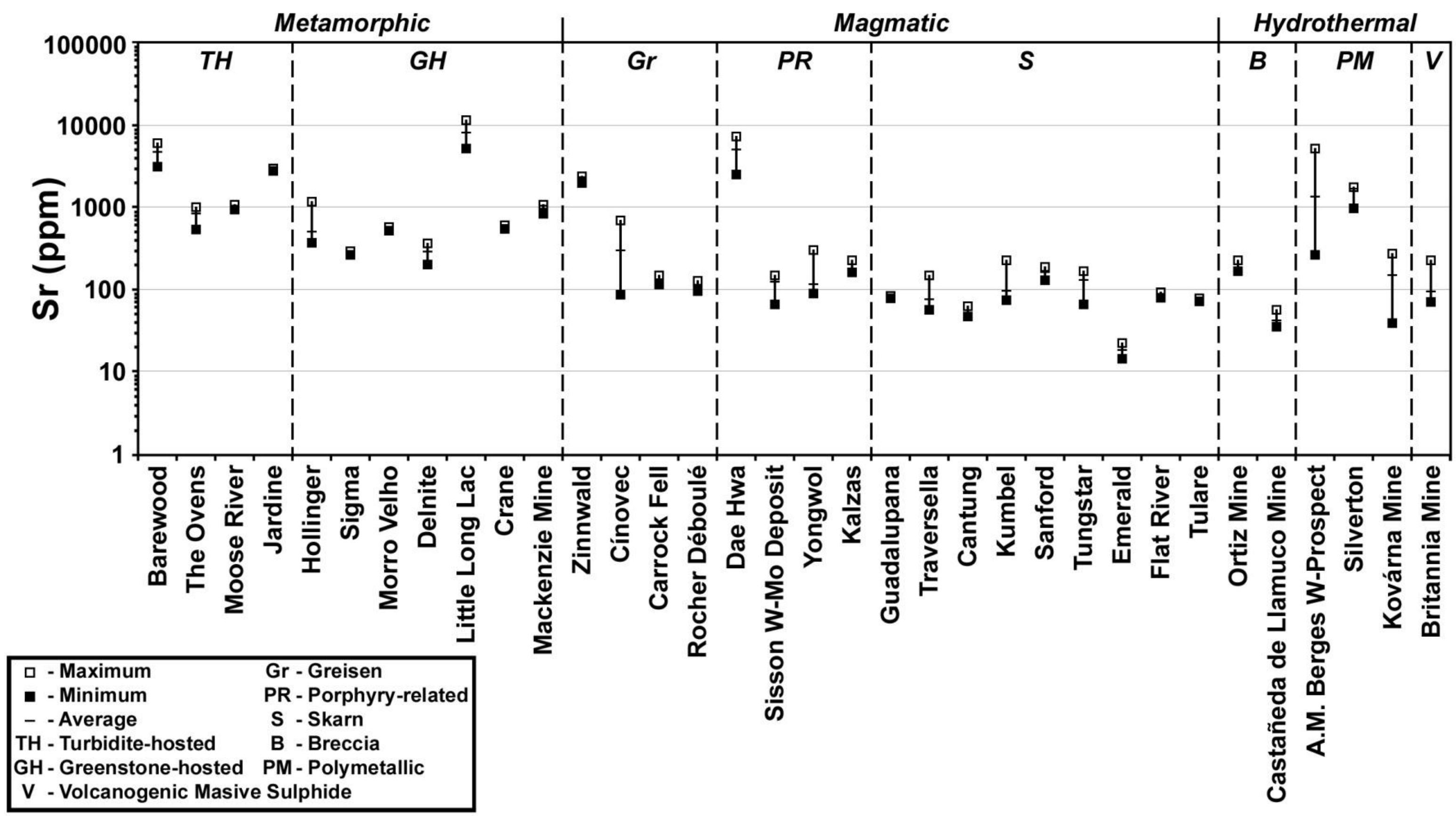

Figure 3.4. A plot summarizing the Sr concentrations (log scale) in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

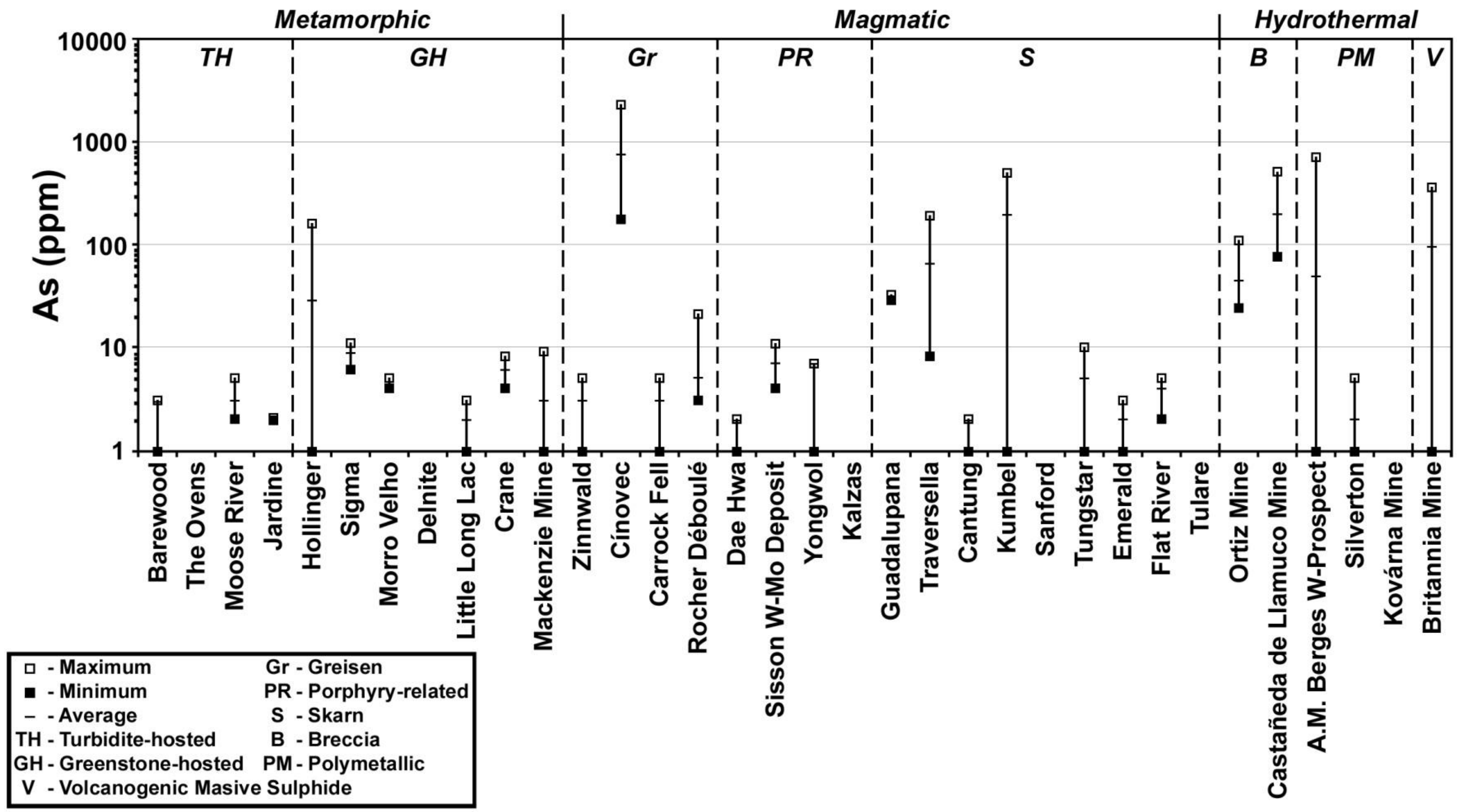

Figure 3.5. A plot summarizing the As concentrations (log scale) in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

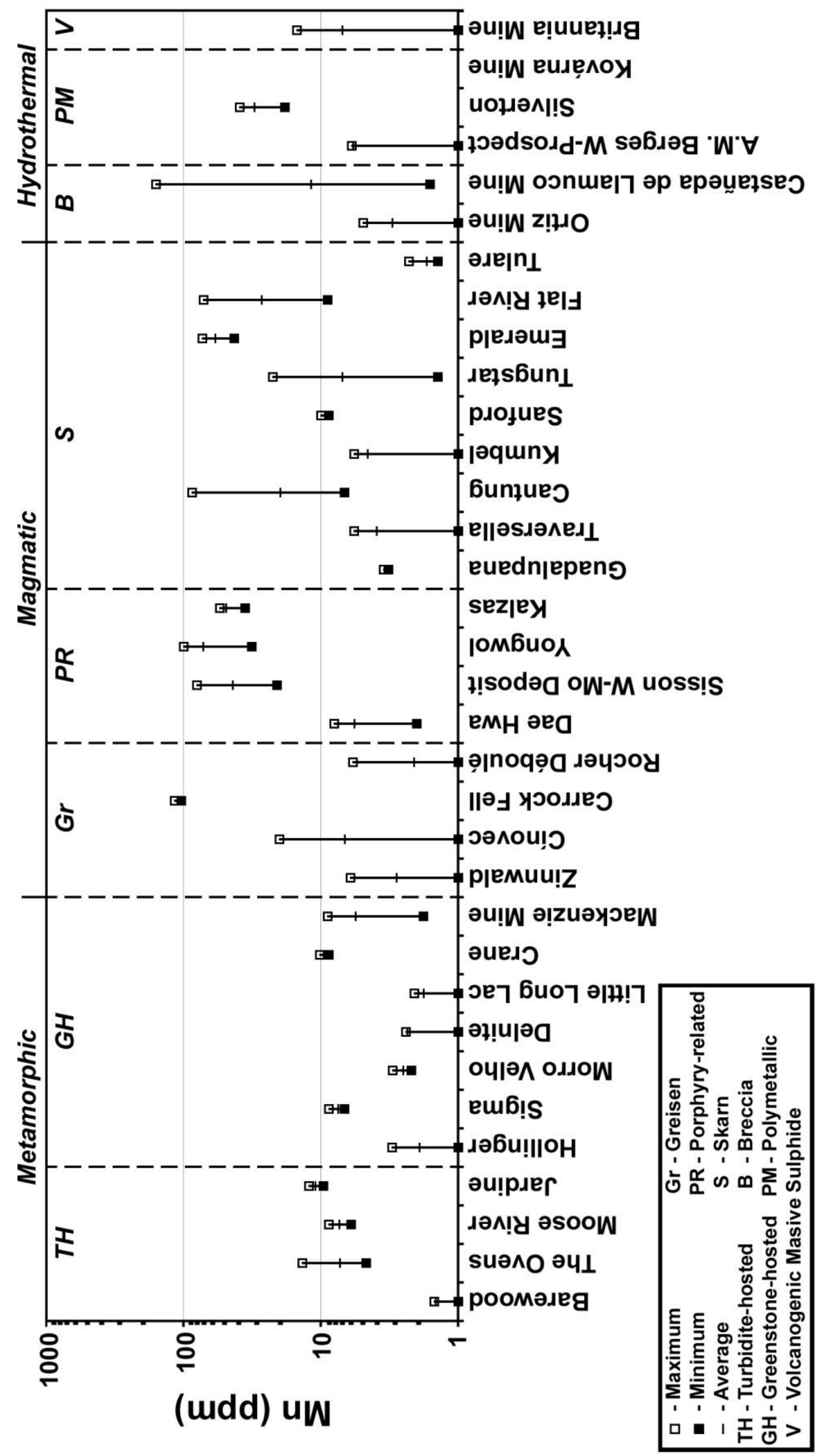

Figure 3.6. A plot summarizing the Mn concentrations (log scale) in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

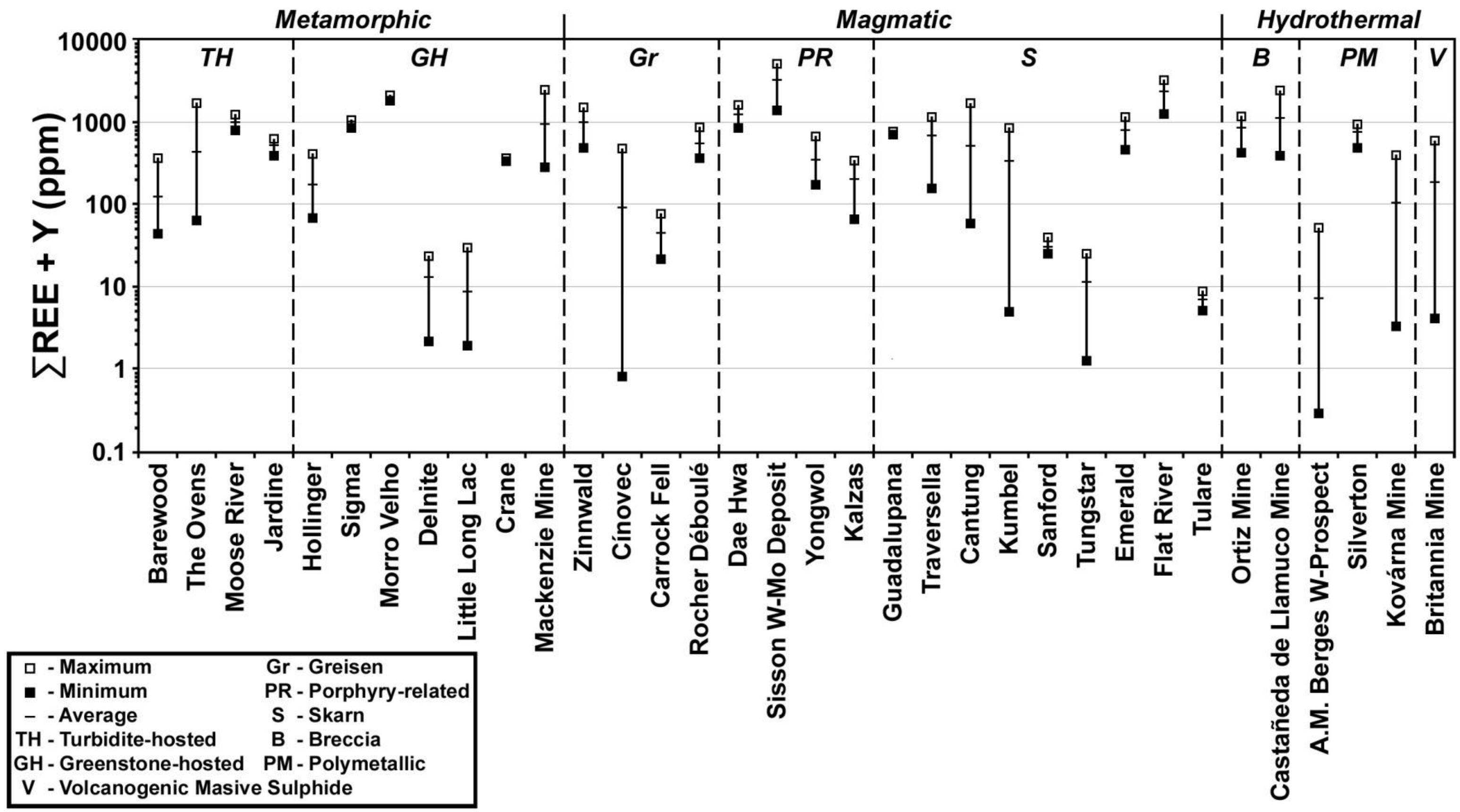

Figure 3.7. A plot summarizing the total rare-earth element plus Y concentrations (ΣREE+Y; log scale) in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

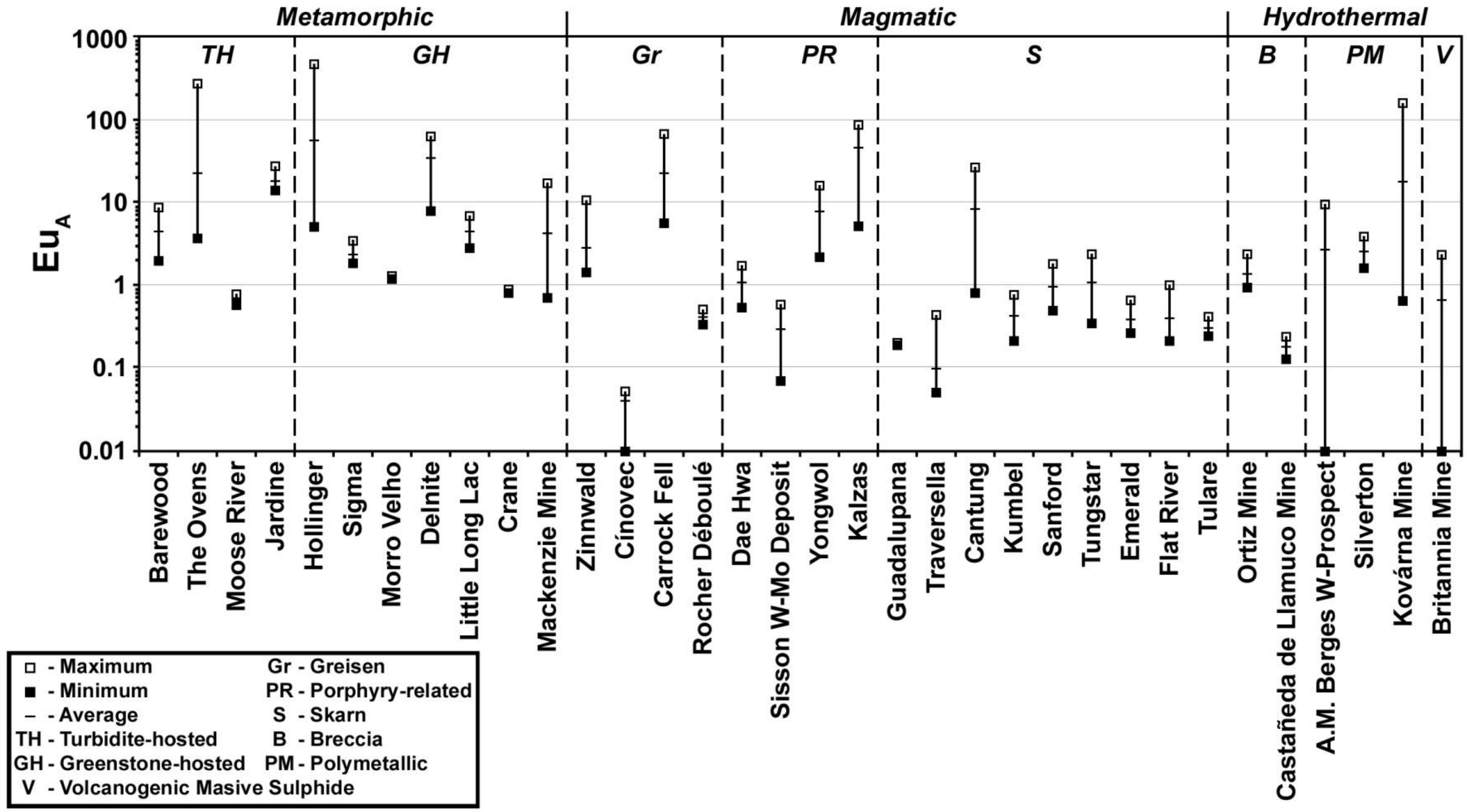

Figure 3.8. A plot summarizing the Eu anomaly, defined as Eu/Eu*, in scheelite analysed from various ore deposit settings. The complete details for the deposits are summarized in Table 1.

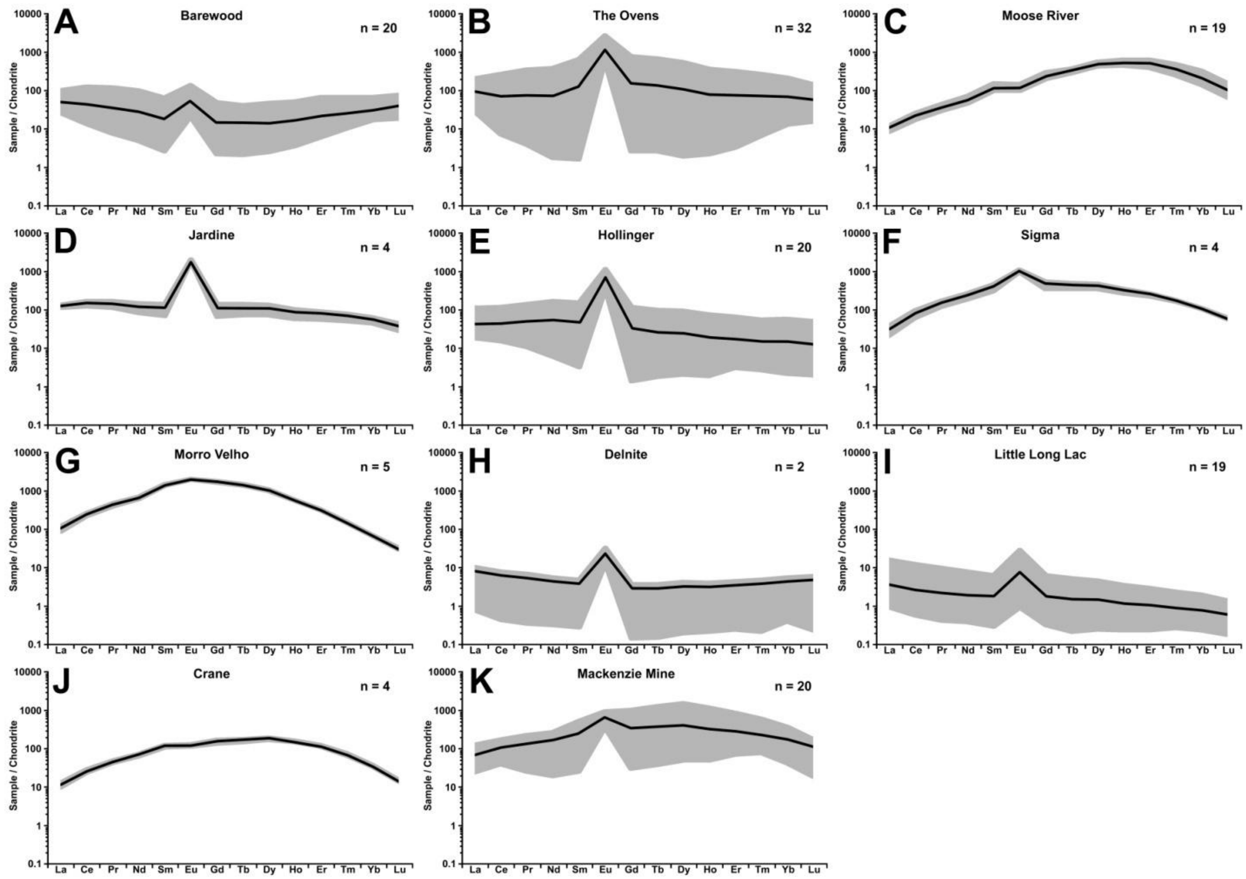

Figure 3.9. Chondrite-normalized rare-earth element plots for scheelite analysed from deposits interpreted to be related to metamorphic fluids. Chondrite values are after Sun and McDonough (1989). The black line in each plot represents the average for all samples analysed, as indicated by n.

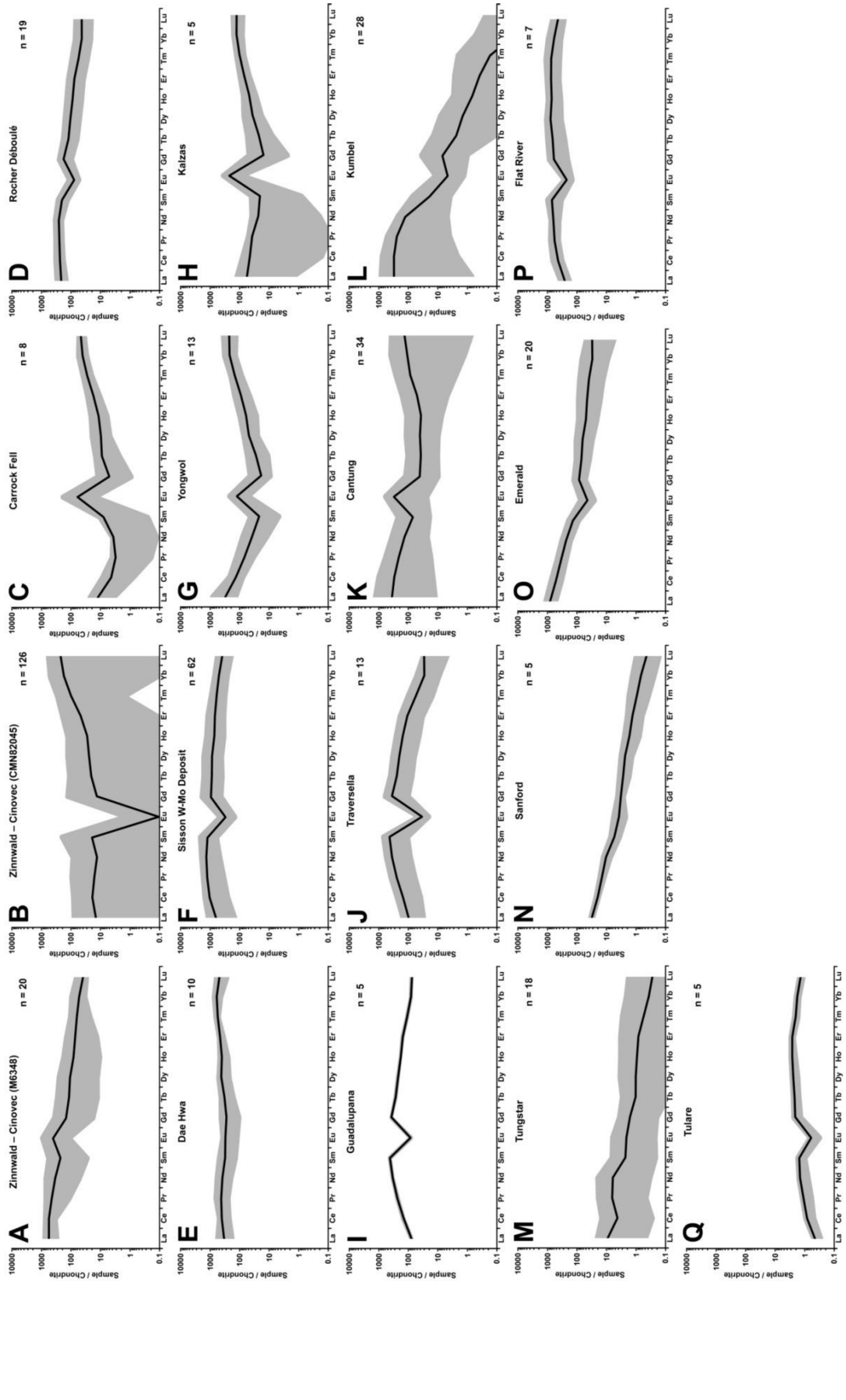

Figure 3.10. Chondrite-normalized rare-earth element plots for scheelite analysed from deposits interpreted to be related to magmatic fluids. Chondrite values are after Sun and McDonough (1989). The black line in each plot represents the average for all samples analysed, as indicated by n.

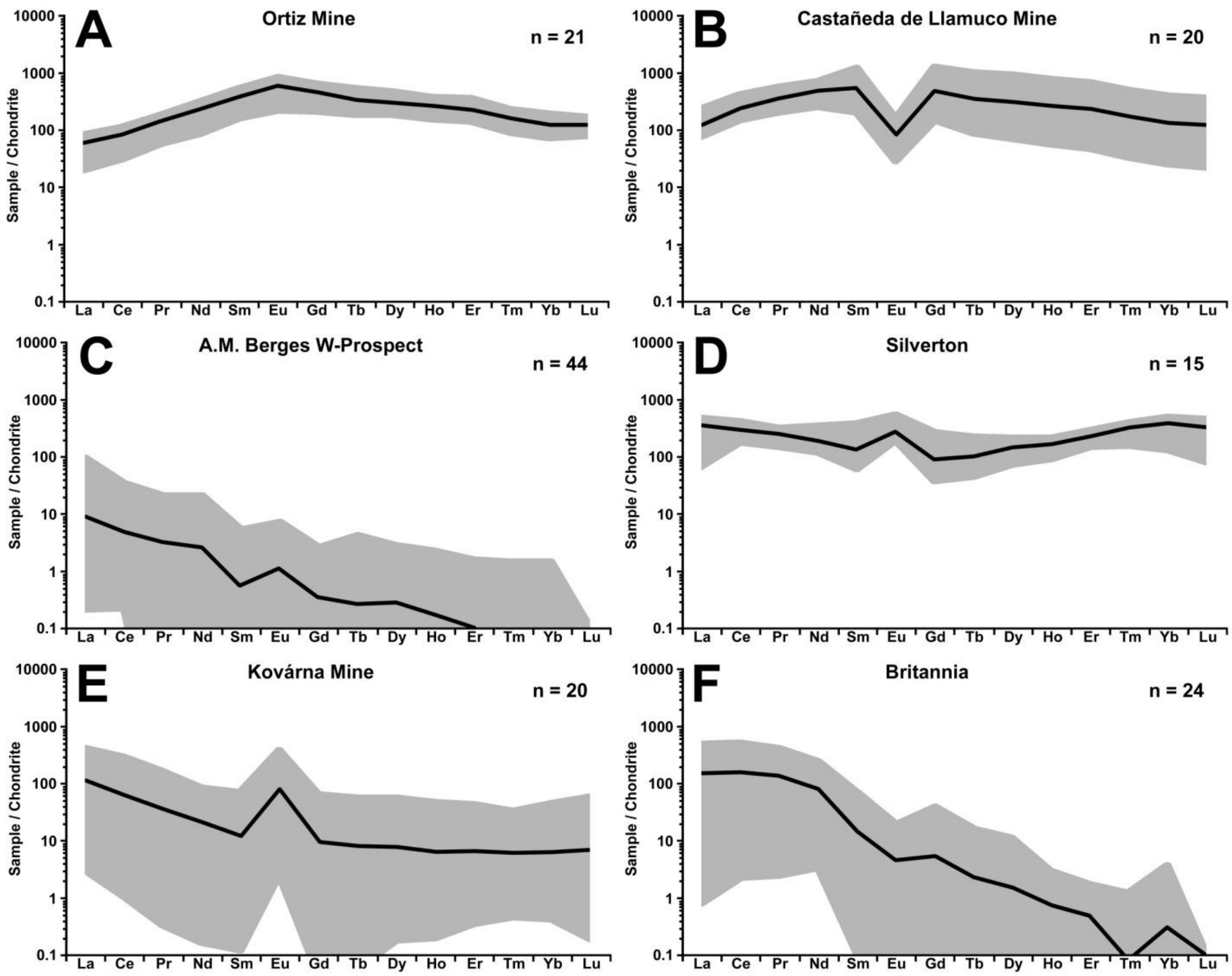

Figure 3.11. Chondrite-normalized rare-earth element plots for scheelite analysed from deposits which have an undetermined or mixed fluid origin. Chondrite values are after Sun and McDonough (1989). The black line in each plot represents the average for all samples analysed, as indicated by n.

3.4.2.1. Metamorphic scheelite

Metamorphic scheelite is relatively depleted in Mo (≤695 ppm) compared to the other samples, in fact if the single anomalous sites are excluded (i.e., Crane) then values are <10 ppm. In contrast, these sites are relatively enriched in Sr (≤11 480 ppm) with an average of about 1000 ppm. Arsenic and Mn contents are also low with values <10 ppm, except for the Hollinger site which Mo ranges up to 200 ppm for one analysis. For all the trace elements (Mo, Sr, As, Mn), the ranges within a single site are however much less than that for all the deposits sites.

There is a large range in ΣREE+Y as a group, from 2 to 2400 ppm, but this value is more uniform if the data for Delnite and Little Long Lake are excluded. The Eu_A for the sites are always positive and range from near unity to near 100 with an average of 10. In general, two are types of CN-REE patterns: (1) those that are relatively flat (Fig. 3.9B, D, E) or with slightly fractionated patterns (Fig. 3.9A, H, I) and variable Eu_A and (2) those with a convex pattern with variable location of the maximum between middle (M) REE (Fig. 3.9G) and heavy (H) REE (Fig. 3.9C) with either no Eu_A anomaly or a minor positive one. Of particular note is that whereas this latter group of scheelites with convex patterns show little range in their ΣREE, the other scheelites have a large range in ΣREE, but the pattern remains uniform.

3.4.2.2. Magmatic scheelite

Magmatic scheelite shows a large over range in Mo values from low ppm levels to in excess of 100 000s ppm in rare cases (Zinnwald-Cínovec, Emerald; Fig. 3.3), but with an average near 1000 ppm. Samples from two of the sites have uniformly lower values between 1-10 ppm and depart markedly from the others, which are generally more uniform between 100-1000 ppm. In contrast, Sr shows relatively uniform ranges both for within and between sites with an overall average of 100 ppm; the only two exceptions to the latter are for Dae-Hwa (300 ppm avg.) and Emerald (200 ppm avg.). For both Mo and Sr there is no correlation between deposit type and the contents of either element in the scheelite, although there is in general more enrichment in skarn sites than the other deposit types. Arsenic is uniformly low at <10 ppm in all but four locations where values are up to about 200 ppm and in one exceptional case to 2300 ppm (Zinnwald-Cínovec). Similarly low values (<100 ppm) were obtained for Mn. For all the trace elements (Mo, Sr, As, Mn), the ranges within a single site are however much less than that for all the deposits sites.

There is a large overall range for ΣREE+Y, from 1 to 5300 ppm for individual sites with averages from 6 to about 3000 ppm; within single sites, there is also a variation of 10s to 1000s ppm. As a group there is a large range for the Eu_A with values from near 0.1 to 100, and an average around 1; a single anomalous site is at 0.01 (Zinnwald-Cínovec). In detail the sites can be subdivided by deposit type such that both greisen and porphyry deposit samples have Eu_A >1 and for the skarns this value is <1. The CN-REE patterns for magmatic scheelite (Fig. 3.10) are quite variable and the sites are grouped into four different patterns, which is not specific to a deposit type (i.e., greisen, porphyry, skarn). In general, the four types of CN-REE patterns are: (1) a relatively flat pattern associated with no Eu_A or a small negative Eu_A (Fig. 3.10E, F, P). Site Tulare (Fig. 3.10Q) is also grouped with these even though it has slight HREE enrichment; (2) a slightly fractionated pattern with slight enrichment in the light (L) REE and with variable or no Eu_A (Fig. 3.10A, D, M, N, O). Site Kumbel (Fig. 3.10L) is also grouped with these, but it has a markedly more fractionate pattern; (3) a concave pattern showing relative MREE depletion and a small positive Eu_A (Fig. 3.10C, G, H); and (4) a convex pattern that is MREE-enriched with a negative Eu_A (Fig. 3.10I, J); and it is also noted that for some sites there is large range in ΣREE, but with the overall fractionation remaining the same (e.g., Fig. 3.10C, H, K, L, M), whereas for others there is little variation (e.g., Fig. 3.10D, E, I, J, N, O, Q).

3.4.2.3. Hydrothermal scheelite

The sites attributed to neither metamorphic nor magmatic origin are included here and, as noted above, the origin of these samples are not as well constrained. For these sites, the trace elements show the largest variation with Mo ranging from <10 ppm to 160 000 ppm (16 wt. %), the latter being the highest of any scheelite analysed. Strontium varies from about 30 ppm to in excess of 1000 ppm for a few analyses at one site (A.M. Berges W-Prospect, Mexico). Arsenic varies from <10 to 720 ppm and is amongst the highest values measured in all the scheelites, whereas Mn also shows a large range in values from <10 ppm to near 160 ppm. For all the trace elements (Mo, Sr, As, Mn), the ranges within a single site are however much less than that for all the deposits sites.

The ΣREE+Y cover a large range, from <1 ppm to 2500 ppm, with both broad and narrow ranges within a site. Similarly, the Eu_A is highly variable with values from <0.1 to near 200 and again with both small and large ranges in single sites. The CN-REE patterns define three groups: (1) a convex pattern with MREE enrichment and having a variable Eu_A (Fig. 3.11A, B); (2) a fractionated pattern with LREE enrichment and positive Eu_A (Fig. 3.11E), or no anomaly (Fig. 3.11C, F); and (3) an unfractionated pattern with a small Eu_A (Fig. 3.11D).

3.4.2.4. Inclusions

Laser ablation-ICP-MS analyses exhibit local spikes for elements that are considered atypical for scheelite and thus not likely present as elemental substitutions (e.g., Fe, Cu; small cations). The spikes suggest the presence of mineral inclusions and, given their chemistry, could represent micro- to nano-scale inclusions of wolframite and/or powellite, in addition to an unknown Cu phase (e.g., A.M. Berges W-Prospect). These inclusions are identified by the presence of large Fe, Cu, Mn, or Mo spikes in the time-resolved analytical signal. Because of their abundance, Ca and W concentrations are not usually affected. Other relevant trace elements concentrations, such as Sr and ΣREE+Y, are also not affected and contribute useful data. However, some mineral inclusions, such as powellite ($CaMoO_4$) and wolframite [$(Fe\text{-}Mn)WO_4$], could have affected the minor- and trace-element data, thus these segments of the data were excluded from the processing.

3.5. Discussion

The main objectives of this study were to characterise different geochemical parameters, namely $\delta^{18}O$ and trace and REE chemistry, in scheelite in terms of assessing if these indices could discriminate different ore deposit types. In the case of $\delta^{18}O$, the data is potentially useful in: (1) examining scheelite for similarities or differences, which could allow distinction therefore between previously proposed polygenic (Ghaderi *et al.* 1999) and singular (Brugger *et al.* 2000*b*) fluid models for the formation of scheelite within single deposits; (2) assessing whether scheelite-forming fluids define natural groupings, based on their isotopic signatures which would imply similar reservoirs; and (3) examining the isotopic variability in individual ore deposits using a combination of the new scheelite data and previously published data on other phases (e.g., quartz).

This study also focused establishing a geochemical database of scheelite from different ore deposit types. In particular, the REE are well established as petrogenetic indicators in the earth sciences, especially for magmatic systems (e.g., Lipin & McKay 1989) which is of particular relevance here given that some of the largest W deposits are related to magmatic systems (e.g., Kwak 1987; Thompson *et al.* 1999). In addition, the REE are used to estimate and track the redox conditions in a melt by documenting the variation in different oxidation states of Eu. The REE are also commonly used to infer the nature and origin of fluid sources in hydrothermal systems, but their use has been hindered by the complexity of the controls on REE fractionation in such environments (see reviews by Gieré 1996 and Debruyne *et al.* 2015). The REE concentration in hydrothermal minerals is dependent a number of factors, which include fluid chemistry (e.g., redox and pH) and temperature, these variables combining to determine the REE speciation (i.e., nature of the stable complexes) (Sverjensky 1984). In addition, non-equilibrium effects, such as sector zoning, can also cause fractionation of the REE (e.g., Rakovan & Reeder 1996) along with other crystallising phases (e.g., Raimbault *et al.* 1993). Despite these complexities, the geochemical data assembled for scheelite in this study is used to assess the nature of its parent fluid and in doing so address the nature of the ore system from which it came. This latter information provides the basis for using scheelite as an ore deposit discriminator in the same context as has been suggested using, for example, magnetite (Dupuis & Beaudoin 2011; Boutroy *et al.* 2014; Dare *et al.* 2014) and chalcopyrite (Lazich *et al.* 2010). In the following sections, the oxygen isotopic and trace element data, in particular the REEs, are discussed in the context of what they indicate in terms of processes and potential application as ore deposit discriminators.

3.5.1. Oxygen isotope data

As noted above, the scheelite $\delta^{18}O$ values vary widely in a given deposit, in specific deposit types, and between the three main deposit types. The range noted here, this being -4.6 to +12.7‰, is not unprecedented and examining data from previous studies for scheelite from a variety of deposits indicates again that uniform data can be obtained within a deposit, but large ranges are noted for deposit types. For example, several studies of scheelite from skarn settings indicate $\delta^{18}O$ values of +5.1 to +6.5‰ at Cantung, Northwest Territories, Canada (n = 5; Yuvan 2006), +1 to +1.3‰ at Grey River, Newfoundland, Canada (n = 2; Higgins & Kerrich 1982), +3.6 to +5.7‰ at King Island, Tasmania (n = 24; Wesolowski & Ohmoto 1986), +5.6 to +5.8‰ at Kara, Tamania (n = 3; Singoyi & Zaw 1998), and +2.8 to +3.3‰ at Nuri, Tibet (n = 5; Chen *et al.* 2012). These values compare to $\delta^{18}O_{scheelite}$ of +4.8 to +5.1‰ in orogenic quartz-scheelite veins in the metasandstones of the Otago Schist, New Zealand, (n = 2; Paterson 1982), +11.7 to +12.6‰ in mica schists in Greece (n = 10; Kilias & Konnerup-Madsen 1997), +7 to +8.4‰ for epigenetic veins in an epithermal setting, Guatemala (Guillemente & Williams-Jones 1993) and +4.2 to +5.5‰ for a granite-related vein system at Dajishan, China (n = 4; Sheih & Zhang 1991). The most thorough and insightful previous study is that of Shelton *et al.* (1987) who document a range of +2.2 to -6.7‰ for scheelite in a granite-related vein system (n = 21), but detailed analyses of core to rim of scheelite show ranges from about +2 (rim) to -6‰ (core) in single grains. Collectively, therefore, both this study and that of previous workers indicate that the $\delta^{18}O$ values of scheelite range from -6.7 to +12.7‰ and there is no specific value that characterizes a deposit type. As will be discussed below, there are many factors which may singularly or collectively affect the $\delta^{18}O$ values of scheelite.

Variation in the $\delta^{18}O$ values can be interpreted in two ways: (1) different reservoirs or sources (magmatic *versus* metamorphic), or (2) processes specific to scheelite formation. The influence of the fluid source on $\delta^{18}O$ values of scheelite is addressed first followed by process-related parameters including: (1) change in temperature during mineralization; (2) variable partitioning of ^{18}O among cogenetic phases, and contamination; (3) closed- *versus* open-system fractionation; (4) wall-rock contamination; and (5) fluid mixing.

3.5.1.1 Source control

The range in scheelite $\delta^{18}O$ values produced by this and other studies is too large to represent a single fluid reservoir and suggest therefore either different reservoirs for the fluids, as in keeping with the variety of deposit types (Table 3.1) or a combination of the two. As has been well established in natural fluid reservoirs (meteoric, magmatic, metamorphic), $\delta^{18}O_{H2O}$ ranges from -40 to +33 ‰ (e.g., Taylor & Sheppard 1986; Sheppard 1986; Rollinson 1993) with meteoric fluids having the largest range (-40 to +6 ‰). The $\delta^{18}O$ values of metamorphic fluids range from +3 to +20 ‰ and magmatic fluids fall into mantle to juvenile types at +5.5 to +9.5‰ or the heavier Cornubian type with values of +9.5 to +13.2‰ (Sheppard 1977), which reflect a fluid sourced in a crust-derived granite. Using the data generated in this study and the appropriate fractionation factors, the $\delta^{18}O_{H2O}$ values are displayed graphically in Figure 3.2 with the fields for the scheelite samples, as classified by deposit type, superimposed using temperature ranges of 400–200°C (the same data is summarized in Table 3.2). It is quite clear that there is no simple separation of data into populations and instead there is a large overlap of data sets. Simply stated, this means that the scheelite samples do not record unique reservoirs that can be used to discriminate deposit settings or types. Examples of calculated $\delta^{18}O_{H2O}$ to illustrate this (calculations at 350°C, Table 3.2) are Cantung skarn (+7.9‰), Zinnwald-Cínovec greisen (+4.6 to +5.6‰), Sisson W-Mo deposit porphyry (+2.3 to +7.8‰), Sigma orogenic gold system (+5.2 to +6.6‰), and Meguma orogenic veins (Moose River = +7.9 to +9.8 ‰, The Ovens = +5.9 to +7.8‰). Thus deposits of highly varied type overlap in terms of their $\delta^{18}O_{H2O}$, which is a value that has commonly been used to discriminate or assess ore systems (e.g., Taylor

1979). Another equally important implication of the diagram is that for most of the samples of inferred metamorphic and magmatic genetic affiliation, the calculated $\delta^{18}O_{H2O}$ is too low, which implies that these values have been shifted due to some process, which is explored below.

3.5.1.2. Process control

3.5.1.2.1. Effect of fluid cooling

Given that the formation of most ore deposits occurs over a range of temperature (e.g., Poulsen *et al.* 2000; Hannington *et al.* 2005; Meinert *et al.* 2005; Seedorff *et al.* 2005) and that isotopic fractionation is temperature dependent, it might be expected that cooling accounts for some of $\delta^{18}O$ variation in the scheelites. Furthermore, most scheelite precipitates between 250º and 350ºC, based on fluid inclusion data (Broman *et al.* 1994; Singoyi & Zaw 2001; Olivo *et al.* 2006) and the theoretical solubility of scheelite (Wood & Samson 2000). Using the scheelite fractionation equation of Zheng (1992) and resulting fractionation diagram (Fig. 3.2), a fluid with an initial $\delta^{18}O_{H2O}$ value of 8.0‰ cooling from 400º to 200°C would precipitate scheelite having a variation in $\delta^{18}O$ of +4.3‰. The observed range in the $\delta^{18}O_{scheelite}$ data is too large to only reflect cooling of a fluid with a uniform isotopic composition, although ranges of 1 to 2‰ can be accounted for by this process (i.e., from 350° to 250°C).

3.5.1.2.2. Effect of mineral impurities and contamination

The mineral most commonly associated with scheelite is quartz, the only exception to this being skarn deposits where quartz is generally absent. Consequently, the presence of quartz inclusions should be considered as a potential contaminant that can influence measured $\delta^{18}O$ values. A fluid with a $\delta^{18}O_{H2O}$ value of 5.7‰, co-precipitating scheelite and quartz, would produce values of +4.1 and +9.8‰ at 400°C and 3.0 and 17.4‰ at 200°C, for scheelite and quartz, respectively (Clayton *et al.* 1972; Zheng 1992). In such a case, 10% of quartz contaminating the scheelite would produce an increase in the measured $\delta^{18}O$ of scheelite from +4.1 to +4.2‰ for formation at 400°C, and from 3.0‰ to 3.4‰ at 200ºC. In this study our SEM-EDS work indicated minimal quartz contamination and/or intergrowths, and so quartz could not have contributed significantly to the $\delta^{18}O_{scheelite}$ values. Even at relatively high contamination values, or over a large temperature range, quartz could not change $\delta^{18}O_{Scheelite}$ values significantly.

3.5.1.2.3. Effect of closed versus open system fractionation

The $\delta^{18}O$ values of minerals precipitated in a vein system reflect whether the system was open or closed, because most vein minerals (e.g., quartz, carbonate) prefer the heavier isotope (^{18}O). Qualitatively considered, in a closed system the $\delta^{18}O$ of a fluid precipitating quartz must therefore decrease from its original value if one assumes standard Rayleigh fractionation for a system at 400ºC where $\Delta_{quartz\text{-}H2O}$ = 4‰ (e.g., Clayton *et al.* 1972). If this system continued to remain closed, then $\delta^{18}O_{quartz}$ must decrease as the amount of fluid decreases since the $\delta^{18}O_{H2O}$ is also decreasing, the process having been modelled by Kontak *et al.* (2016). For scheelite crystallising at different stages in a closed system, $\delta^{18}O_{H2O}$ would actually increase through the paragenesis at a constant temperature given that above 250°C the $\Delta_{scheelite\text{-}H2O}$ is <1. In this simple model, several factors are relevant: (1) the position of scheelite in the paragenesis (because the bulk $\delta^{18}O_{H2O}$ value will change through time); (2) the temperature at which scheelite forms; and (3) the mineral assemblage present and, Δmineral-H_2O values for these additional phases. This latter aspect becomes relevant if for example quartz is precipitating as it would change the $\delta^{18}O_{H2O}$ of the system (i.e., decrease it).

For the metamorphic ore systems considered here, where the $\delta^{18}O$ values range from +3.3 to +8.8‰, closed-system fractionation (i.e., mineral and co-existing fluid) is considered more prevalent than open flow-through systems, that is the ore systems reflect repeated episodes of dilation during fluid overpressuring (e.g., Sibson *et al.* 1988; Poulsen *et al.* 2000). In such systems, vein formation is short-lived and mineral precipitation is caused by changes in fluid pressure. The general lack of wall-rock alteration accompanying vein formation in, for example, sediment-hosted metamorphic ore deposits (Bierlein & Crowe 2000) is evidence of the brevity of vein-precipitation events. Thus it is suggested that some of the observed range in $\delta^{18}O_{scheelite}$ may be related to Rayleigh fractionation processes.

3.5.1.2.4 Effect of wall-rock contamination

Although only limited information is available to evaluate the effect of interaction of the mineralizing fluid with the wall rock and therefore contamination of the fluid, this phenomenon can still be qualitatively assessed. Of the environments examined, skarns show the most evidence for extensive wall-rock interaction during mineralization (Meinert *et al.* 2005). It is also noteworthy that the country rocks associated with skarns are significantly enriched in $\delta^{18}O$ compared to other lithologies (e.g., metasiltstones, granites, metavolcanics), which likely reflects the fact these lithologies are dominated by carbonate rocks that generally have elevated $\delta^{18}O_{H2O}$ signatures due to the high values of carbonate-H_2O fractionation at low temperatures (e.g., Friedman & O'Neil 1977; Chacko *et al.* 2001; Bindeman 2008). Scheelite from such settings (e.g., Hermosillo, Guadalupana, Sangdong, Traversella, San Alberto, Cantung, and Kumbel) does not exhibit markedly enriched $\delta^{18}O$ values, which implies that fluid-rock interaction is not an important process and that these are high fluid:rock ratio systems. A similar observation has been made based on vein mineral $\delta^{18}O$ data for the metaturbidite-hosted orogenic Au deposits in the Meguma terrane (e.g., Kontak & Kerrich 1997). In this study the scheelite from the same setting is not enriched in ^{18}O (+4.9 to +8.8‰; Moose River, The Ovens) despite the host rocks having $\delta^{18}O$ values >+12‰ (Kontak & Kerrich 1997). Thus, there is little evidence to conclude that fluid-rock interaction at the site of ore formation contributed significantly to the observed range of $\delta^{18}O_{scheelite}$ values.

3.5.1.2.5. Variations in fluid composition

The variation in $\delta^{18}O_{scheelite}$ cannot be accounted for solely by the various mechanisms discussed above, although each may have contributed in some degree towards the observed ranges in the $\delta^{18}O_{scheelite}$ values. In particular these mechanisms cannot explain the light $\delta^{18}O$ values noted (Figs. 3.1, 3.2) as the aforementioned processes all act to increase the $\delta^{18}O$ of the fluid and thus that of scheelite, the exception being aspects of the fractionation model, which are discussed below.

In order to account for the $\delta^{18}O$ values, we appeal therefore to fluid mixing, which is a common and established phenomenon in a variety of hydrothermal ore systems, especially in intrusion-related settings such as porphyry and epithermal (e.g., Ohmoto & Rye 1979). In these cases, magmatic fluids having $\delta^{18}O_{H2O}$ values greater than about +8‰ (Taylor 1979; Sheppard 1986) mix with isotopically depleted meteoric water for which there is often supporting complementary evidence from, for example, fluid inclusion studies (e.g., Roedder 1984; Bodnar *et al.* 2014). For the previous studies cited above where $\delta^{18}O_{scheelite}$ values are <+5-6‰, then for 350°C or less this equates to $\delta^{18}O_{H2O}$ of <+8‰ (Fig. 3.2) and suggests possible fluid mixing. In the present case, the data in Figure 3.1 clearly show that regardless of the fractionation factor used, variable amounts of fluid mixing is required to explain the light $\delta^{18}O_{H2O}$ values calculated with most <+8‰, even for the metamorphic sites, and a large amount even fall at <+6‰. Thus, fluid mixing is the preferred explanation for the magmatic and hydrothermal sites and therefore agrees with the conclusions of previous studies of scheelite in similar settings.

Of note in the fluid mixing model however, is that it is difficult for meteoric fluid to heat up to say 300° or 400°C in the case of metamorphic settings (i.e., 3 kbars), such as those examined here and not chemically exchange with its wall rock and thus loses its isotopic identity of depleted $\delta^{18}O_{H2O}$. We suggest therefore that in such cases the closed system fractionation model, or Rayleigh distillation, may be relevant. In this case formation of quartz, which dominates metamorphic vein systems in general, will become depleted in $\delta^{18}O_{H2O}$ to values <+6‰ for an initial fluid of +10 to +12‰ after 50% crystallisation (Kontak *et al.* 2016). If scheelite were to form at this stage in the vein, it would therefore inherit a low $\delta^{18}O_{H2O}$ value such as documented in some of the metamorphic settings here.

3.5.2. Trace-element data

Scheelite ($CaWO_4$) is tetragonal and its crystal structure has two unique cation sites: an [8]-coordinated site that can incorporate relatively high amounts (100 to 10 000 ppm) of REE^{3+} and Sr^{2+} into the Ca^{2+} site, and a [4]-coordinated site where Mo^{5+} and As^{5+} are substituted for W^{6+} (Poulin *et al.* 2016 and references therein). These crystallographic and chemical characteristics make scheelite a useful geochemical tracer for mineral deposits and related processes. Of particular relevance in terms of the significance of the trace element data is that although there are large overall ranges for all the elements (Mo, Sr, As, Mn), within scheelite from a single ore deposit there is a much more limited variation, the significance of which will be addressed below.

3.5.2.1. Molybdenum substitution

Owing to the similar charge and ionic radii between W and Mo ($^{[4]}rW^{6+}$ = 0.42 Å *versus* $^{[4]}rMo^{6+}$ = 0.41 Å; Shannon 1976), Mo can easily be incorporated in the scheelite structure, but its concentration is strongly influenced by redox conditions due to the redox sensitivity of this element. Under oxidising conditions, Mo migrates as Mo^{6+}, typically in an H_2MoO_4 complex in the fluid (Rempel *et al.* 2009), whereas under reducing conditions Mo is present as $Mo^{4+}$and commonly precipitates as molybdenite (Linnen & Williams-Jones 1990; Luo *et al.* 1991). In contrast, recent work by Che *et al.* (2013) suggests that, unlike Mo, W may be present as W^{6+}, even under moderately reducing conditions. These redox sensitive elements are both present together in scheelite, therefore it might be expected that the concentrations of Mo may relate to the prevailing chemical conditions in different ore deposit settings.

In general, the data summarized in Figure 3.3 shows there are both inter-deposit and intra-deposit variations. The first indicates that within a single deposit there is limited variation, although there are clearly some exceptions such as at Zinnwald-Cínovec and A.M. Berges W-Prospect. These uniform Mo contents suggest that redox conditions were generally uniform during scheelite growth as departures would presumably affect the ability for Mo to substitute in the scheelite structure. It can be concluded therefore that in general both the redox conditions in the mineralized environment and the Mo content of the fluid remained constant. As for intra-deposit variation, there is a clear enrichment of Mo in the magmatic-related scheelite *versus* the metamorphic (Fig. 3.3) with the former having >100 ppm Mo, in rare cases >100 000 ppm, and the latter <10 ppm Mo. Based on the redox sensitive nature of these elements, the first point to be made is that the metamorphic deposits could represent more reduced settings that inhibit Mo from being in the appropriate redox state (i.e., Mo^{6+}) to substitute into the scheelite structure.

Alternatively, it could also be that the fluids in the magmatic related settings are relatively enriched in Mo, as is expected given that the global resource of Mo comes from mineralized felsic plutonic centres (e.g., Seedorff *et al.* 2005). The advent of *in situ* micro-analytical techniques, such as LA-ICP-MS, provide the means to test this hypothesis by analysing fluid inclusions in these settings to see if there is a relationship between the Mo content of the fluids and scheelite. Lastly, based on the elevated Mo contents of the hydrothermal group scheelites, the data for the first two groups suggests a magmatic affinity for these settings.

3.5.2.2. Strontium substitution

Scheelite is easily able to accommodate Sr, as occurs in other Ca bearing minerals such as carbonates (i.e., as substitution for Ca^{2+}), and less so Rb, so many ore deposit related studies involving the mineral have focused on it within the Sr-Rb isotopic system due to its potential to be an isotope tracer (Deer *et al.* 1966; Bell *et al.* 1989; Anglin *et al.* 1996; Ghaderi 1998). Due to the highly mobile nature of Sr, the presence of Sr and its related $^{87}Sr/^{86}Sr$ isotopic value in scheelite, among other phases (e.g., tourmaline, carbonates) scheelite is commonly used to trace ore-forming fluids (Bell *et al.* 1989; Kontak & Kerrich 1997).

In this study there can be up to two orders of magnitude difference between the Sr content of metamorphic scheelite and magmatic scheelite (Fig. 3.4) and the range is from ~14 to 11 480 ppm. This wide range and high concentration highlights the potential of measuring Sr concentration by SEM-EDS in the investigation of the origin of scheelite where detections limits approach 1000 ppm (i.e., 0.1 wt. %). As to the range noted here, two aspects are significant, the relatively small inter-deposit variation and the intra-deposit differences for deposit types. In the first case, the apparent uniform Sr content of scheelite within a site suggests there has not been a change in the Sr content of the fluid during scheelite formation, which limits processes such as fluid:rock interaction and dilution *via* fluid mixing, as suggested from the $\delta^{18}O$ data discussed above. As for the variation among deposit types, the metamorphic scheelite is clearly enriched over the magmatic related types. An explanation offered is that the fluids in the former are enriched during fluid:rock reaction along the flow path, in contrast to the latter whereby the mineralizing fluids are generally considered to be derived from evolved or fractionated felsic melts, which are relatively depleted in Sr due to their extend fractionation. In these latter deposits the data also suggest limited interaction with the wall rocks, again consistent with the $\delta^{18}O$ data. This is particular relevant to the skarn settings where the host rocks are carbonates, which in general have elevated Sr contents (Kinsman 1969).

3.5.2.3. Arsenic substitution

In general As is not abundant in the scheelite samples studied with contents ≤10 ppm, except in a few sites where values vary from 100s to a few 1000 ppm (Fig. 5). In some cases at least the low values are notable, an example being The Ovens where arsenopyrite is abundant in the deposit setting (i.e., 10–30 modal percent locally; our observations and see Kontak *et al.* 2011), but evidently not in the cogenetic scheelite. In all of the sites, however, the abundances are internally uniform, which suggests that the variability here is either the availability of As or crystal-chemical controls. As either arsenopyrite or arsenian pyrite is generally present in many of the ore deposit settings studied (e.g., Goldfarb *et al.* 2005; Seedorff *et al.* 2005), it is likely that the crystal-chemical considerations govern the As concentration present in scheelite. It should be noted that the substitution of As^{5+} for W^{6+} may be limited due to the differences in valence and ionic radii (${}^{[4]}rAs^{5+}$ = 0.335 Å *versus* ${}^{[4]}rW^{6+}$ = 0.42 Å; Shannon 1976). In the case of the valence, vacancies, coupled substitutions or other mechanisms may compensate for the charge and the radius issues, although for at least a few of the localities these factors are evidently overcome. We suggest therefore that redox may be a factor here and that in many cases As occurs in a reduced state (As^{3+}) and that this is the limiting factor for substitution. Examining the As data therefore the enrichment noted occurs in magmatic related deposit settings where relatively more oxidized conditions are likely than metamorphic deposits, which would favour As^{5+}. This conclusion is also consistent in the case of the orogenic deposits where low levels of Mo are considered to redox related. Thus, in the case of the high levels of As present at Zinnwald-Cínovec or Kumbel it is possible that more detailed information regarding the paragenesis at this site might provide insight into As enrichment. Again, as noted above for Mo, measuring the concentration of As in scheelite-hosted fluid inclusions could address the issue of As enrichment.

3.5.2.4. Manganese substitution

As with As, Mn is present in low, but consistent abundances within deposits with values below 10 ppm for the orogenic and up to 100 ppm for the magmatic related and other settings (Fig. 3.6). Manganese can substitute in scheelite for either Ca^{2+} or W^{6+} depending on its charge, hence Mn^{2+}, Mn^{4+} or Mn^{5+} which suggests there is also a redox control on the preferred substitution (${}^{[8]}rMn^{2+}$ = 0.96 Å *versus* ${}^{[8]}rCa^{2+}$ = 1.12 Å and ${}^{[4]}rMn^{2+}$ = 0.66 Å, ${}^{[4]}rMn^{4+}$ = 0.39 Å, ${}^{[4]}rMn^{5+}$ = 0.33 Å *versus* ${}^{[4]}rW^{6+}$ = 0.42 Å; Shannon 1976). Without more information as to the nature of the valence of Mn in the scheelite, it is not possible to be more definitive as to the substitution, which may be operative or favourable, as both are present in other naturally occurring mineral phases, such as Mn contents of carbonates, epidotes, and garnets in the case of the Meguma sediment-hosted gold deposits (Kontak & Smith 1993), where scheelites from The Ovens and Moose River deposits are located. As for the redox conditions governed by Eh-pH diagrams, Mn^{2+} would be favoured for metamorphic ore deposit settings where reduced S dominates as a variety of sulphide phases, but for magmatic settings higher oxidation states are likely (e.g., Seedorff *et al.* 2005). With these guidelines, we note that the data in Figure 3.6 show that Mn is higher in the magmatic systems than metamorphic, which suggests again a possible redox control. If this is the case, it suggests that Mn^{4+} is the preferred cation as availability is unlikely to be an issue in the metamorphic deposit settings and instead it is likely a redox control.

3.5.2.5. REE incorporation and REE patterns in scheelite

Only a few experimental and theoretical scheelite/fluid partition coefficients have been published that are relevant here. For fluids ranging from 400-600°C, the scheelite/fluid partition coefficients are estimated at 4400 for Lu and 28 000 for La (Cottrant 1981; Raimbault 1985). These coefficients imply a very strong partitioning of REE into the scheelite structure with a preference for the LREE in a closed system. The concentration and distribution of REE in scheelite should therefore strongly reflect the composition of the fluid from which it crystallized and reflect the variable preference of LREE *versus* HREE (Cottrant 1981). The latter provide the basis therefore of interpreting the REE of ore-forming fluids, based on the REE pattern of the scheelite. With this in mind it is relevant for example to note that in one of the more exhaustive studies of scheelite from an ore setting, this being the Meguma auriferous quartz veins of Nova Scotia, Dostal *et al.* (2009) noted a range in the REE enrichment and patterns that suggest differences in the ore-forming fluid through time and space. The data for the present study are discussed below in this same context.

3.5.2.5.1. REE abundances and patterns in scheelite

The large variability of ΣREE+Y (Fig. 3.7) and CN-REE patterns (i.e., fractionation; Figs. 3.9 to 3.11) in the scheelites suggests differing factors other than composition must govern this variation given that the scheelites analysed are essentially stoichiometric with the exception of only a few samples where Mo contents were 1 to 16 wt. % (Fig. 3.3). The lack of any correlation between ΣREEs and Mo supports this conclusion, but as discussed below there is a relationship between Mo and the redox sensitive Eu_A values. Other factors which are likely relevant in controlling the incorporation of REEs into scheelite are fluid chemistry, an evolving fluid composition (i.e., mixing, fluid:rock interaction) and potentially complex mineral parageneses involving precipitation of other REE bearing phases (e.g., apatite, carbonate). These aspects are therefore alluded to below in the discussion.

Scheelite related to metamorphic settings (Fig. 3.9) is in general similarly enriched in ΣREE, the two notable exceptions being Little Long Lac and Delnite. Important in this context however is that large variations from high to low ΣREE can occur where samples are zoned, such as The Ovens, which is discussed below. As for the CN-REE patterns, scheelite generally shows two types of patterns: relatively flat or slightly LREE enriched with a variable positive Eu_A, or concave with variable maximum in the profile and either lacking or having a small positive Eu_A. In many cases, there is a tight clustering of data (i.e., no fractionation of REEs) from a single deposit which suggests the fluid had a uniform REE content during scheelite formation, it crystallized in an open system and there were no other competing REE phases present or if so their abundance was too small to be significant. In other cases however there is large variation in ΣREE with generally uniform changes in the patterns, although in particular cases there is select removal of the MREEs, as seen for The Ovens and Hollinger samples. The uniform changes in the patterns in these scheelites are considered to reflect closed system fractionation. Most of the samples also have positive Eu_A, which may increase as the ΣREE decreases (e.g., Hollinger, The Ovens, Delnite), whereas at others it remains uniform (e.g., Barewood, Little Long Lac). In the former samples there must therefore be preferential uptake of Eu over the neighbouring REEs (Sm, Gd); further aspects of the Eu_A are discussed later. Lastly, the metamorphic related scheelites generally show very little zoning under CL and therefore the variation in the REE could not be related to growth zones (Poulin *et al.* 2016).

Scheelite from magmatic-related deposit settings are characterized by having site specific patterns and collectively a large range in ΣREEs which covers over 3 orders of magnitude, but for any one site the range is much smaller, except for Kumbel and Zinnwald-Cínovec; in general therefore this contrasts with the metamorphic scheelites (note the two exceptions in Fig. 3.7). These scheelites typically have no single, distinctive REE pattern, and as noted before 4 patterns are recognized – relatively flat, slight LREE fractionated, concave with MREE depletion and convex with MREE enrichment; in addition there are variable Eu_A. Using the ΣREE (Fig. 3.7) and nature of the CN-REE patterns (Fig. 3.10), which are ordered in terms of deposit type (i.e., greisen, porphyry, skarn), it is evidenced there is no simple correlation of these parameters with deposit type. If it is assumed that for each site the analyses with the highest ΣREE represents the least fractionated part of the scheelite, then these patterns may be considered to reflect the primitive signal of the mineralizing fluid. Given that this type of mineralization is associated with a range of intermediate- to felsic, metalumious- to peralumious intrusions the scheelite patterns may therefore in part reflect the chondritic REE profiles of the progenitor intrusions. As the profiles of such intrusions varies widely, in part likely a reflection on how evolved the exposed causative intrusion is in rare-metal (i.e., W, Sn, Ta) mineralized settings (e.g., Keith *et al.* 1997; Taylor 1988; Belvin & Chappell 2004; Černý & Ercit 2005), it is not unexpected that such an array of scheelite patterns are observed. For example, the slight LREE enriched patterns are typical of many felsic intrusions (Fig. 3.10A, M, N, O), whereas the REE depleted (Fig.

3.10Q) and listric-like patterns (Fig. 3.10C, G) of others reflect similar patterns in highly evolved felsic intrusions in rare-metal ore systems (e.g., Taylor 1988; Kontak 1990; Rasmussen *et al.* 2011; Dostal *et al.* 2015). Exceptions to this explanation for many of the patterns, however, are the unfractionated patterns and ΣREE enrichment for three sites (Figs. 3.7 and 3.10E, F, P), and similar patterns, but lesser ΣREE enrichment at others (Fig. 3.10D, I), which require some additional process to account for both of these features. In these cases it might be that fluid:rock interaction may affect the ΣREE in addition to the presence of co-precipitating phases. It is also noted that there is clearly a role for the effect of scavenging of REEs by other phases, such as garnet in skarns (e.g., Song *et al.* 2014), but given the uniform patterns for each site it is not possible to assign a singular influence to the data set as a whole.

As with the metamorphic scheelite, some of the magmatic related varieties also show large variation in ΣREE, but with uniform patterns for single sites, Zinnwald-Cínovec, Kalzas, Kumbel, and Tungstar being examples. Given that these sites represent different ore deposit settings, the process is evidently not specific to any ore environment. Again, the decrease in ΣREE can in general be modelled by closed system fractionation especially where the patterns are generally uniform (Brugger *et al.* 2000*b*), and this is most often the case but exceptions are noted, as is now explored.

That magmatic-related scheelite often shows zoning under CL (Poulin *et al.* 2016) can be used to further examine the change in REE within scheelite, as is illustrated using the Kumbel scheelite (Fig. 3.12). The dramatic change in the LREE fractionation seen in the Z2 part of the scheelite is clearly not part of a post-grain event, since this zone is an integral part of the scheelite. In this case the reduction in the LREE is suggested to reflect loss of the LREE to another co-precipitating phase (e.g., apatite). This example illustrates the need, where possible, to integrate the REE signature of minerals with their growth zones.

The variety of patterns for the magmatic-related scheelites are considered to reflect primarily the REE chemistry inherited from the exsolved fluid form the progenitor and causative intrusion with further modification related to fluid:rock interaction and fraction within a closed system. The variable Eu_A values of these samples are discussed separately below.

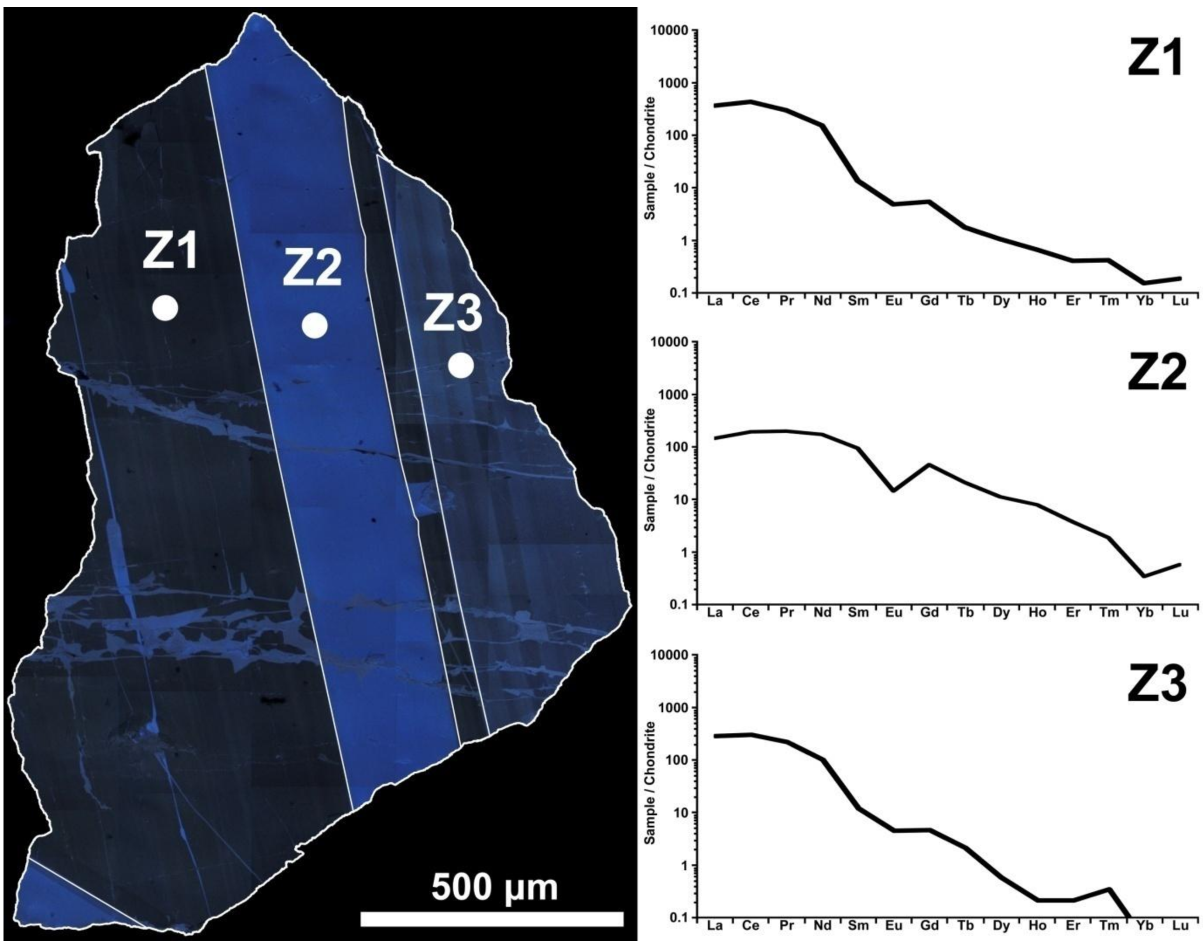

Figure 3.12. Comparison of CL response (left) and chondrite-normalized rare-earth element plots for zones in a scheelite grain from Kumbel, Kyrgyzstan. Chondrite values are from Sun and McDonough (1989).

The last set of REE data are for scheelite samples of poorly constrained genesis that are characterized by highly variable ΣREE, which range over 3 orders of magnitude, and also very different chondritic REE patterns. As with the other scheelites, internally consistent REE fractionation is present at each site such that there is uniform depletion in the all the REEs as the ΣREEs decrease. There are 3 CN REE patterns apparent, as noted before: (1) a convex pattern with MREE enrichment; (2) a LREE enriched pattern; and (3) an unfractionated or flat pattern; each of these 3 patterns have variable Eu_A. The fractionated patterns with LREE enrichment (Fig. 3.11C, E, F) are most similar to the magmatic-related scheelite patterns, whereas the concave and flat patterns are equivocal as they are present in both the metamorphic- and magmatic-related settings. Some of these samples also exhibit complex CL patterns, as with the magmatic scheelite noted above, and provide insight into their growth histories. One such as the scheelite from the Britannia mine is shown in Figure 3.13 to illustrate the zoning which is very insightful as two very different REE signatures are provided, a LREE enriched profile that characterizes the early growth zones (i.e., zones A to D, Fig. 3.13) and a REE depleted and unfractionated pattern for the later overgrowth stage. Again, where it is possible to integrate chemical data with CL imaging, it is clearly invaluable in terms of providing insight into the nature of fluids recorded in scheelite.

3.5.2.5.2. LREE versus HREE fractionation in scheelite

The intensive and chemical parameters of a hydrothermal fluid and the nature of REE speciation in the fluid influence the partitioning of REE between the scheelite and the fluid phase (Brugger *et al.* 2008). As noted already, in a closed system the LREE are preferentially taken up by scheelite (Cottrant 1981; Raimbault 1985) and in many cases (e.g., Zinnwald-Cínovec, Kumbel, Sanford; Fig. 3.10A, L, N) the CN-REE patterns reflect this crystal-chemical control.

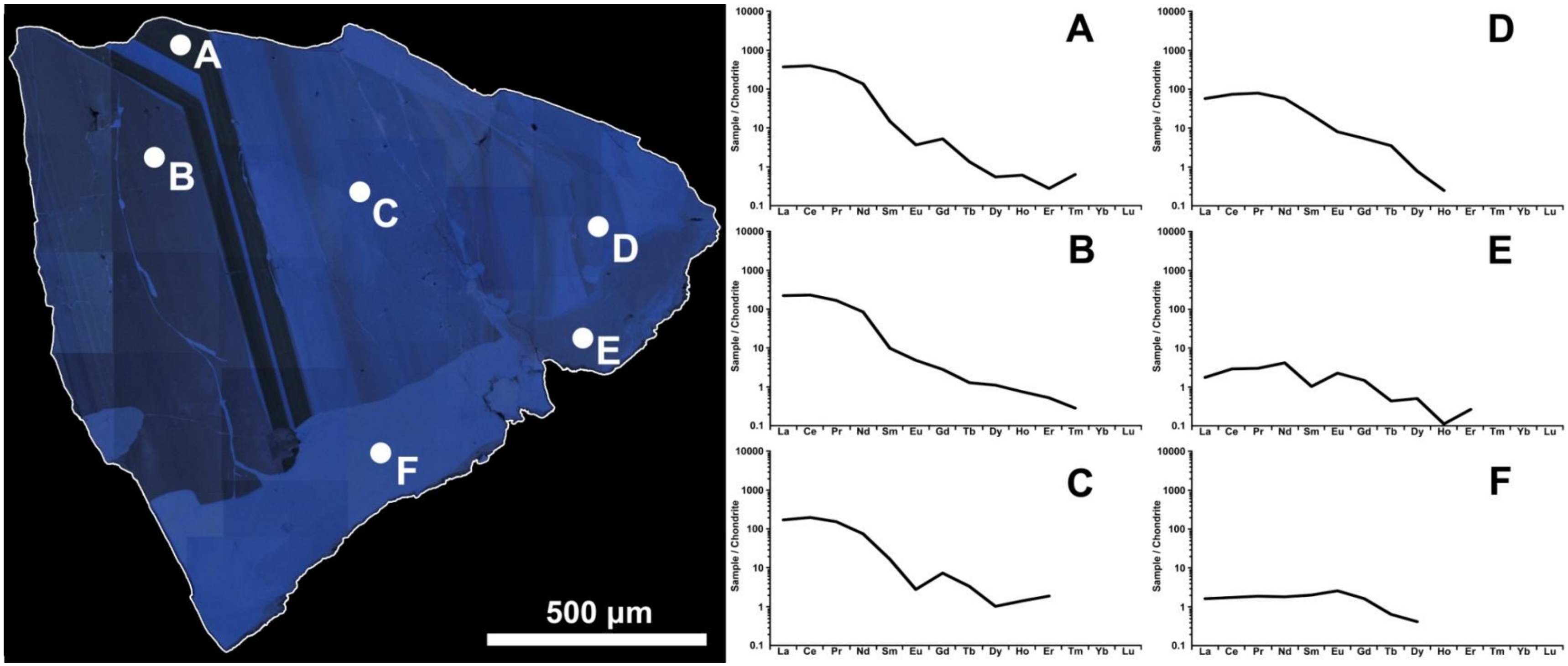

Figure 3.2. Comparison of CL response (left) and chondrite-normalized rare-earth element (REE) plots for scheelite grain from the Britannia Mine, British Columbia, Canada. The chondrite values are from Sun and McDonough (1989). Note that the six laser spot analyses of the scheelite grain, denoted as A to F, there is a notable correlation of decreasing ΣREE and $(La/Lu)_N$ with CL response (i.e., dark to light).

Furthermore, experimental data show that the complexation of REE (e.g., as chloride and fluoride complexes) in hydrothermal fluids can preferentially stabilize LREE over HREE (Flynn & Burnham 1978; Migdisov *et al.* 2006, 2009). Many of the CN-REE patterns show LREE enrichment is consistent with the aforementioned data. Below we explore other aspects of the CN-REE patterns.

It is presumed that the REE patterns in scheelite reflect to a certain degree the relative enrichments of the REEs in the fluid from which it crystallized, as suggested by others (Sylvester & Ghaderi 1997; Brugger *et al*. 2000*b*; Dostal *et al*. 2009) in addition to the influence of co-precipitating phases. For the case of scheelite hosted by skarn deposits, it is reasonable to assume therefore that the inherited REE patterns of scheelite will be influenced by the crystallisation of either earlier- or paragenetically overlapping skarn minerals (e.g., garnet, pyroxene, wollastonite; Graunch 1989; Bea *et al*. 1997; Zhang H. *et al.* 2000; Boyd *et al.* 2004). Garnet, in particular, shows a preference for HREE and should result in a relatively LREE-enriched residual fluid from which scheelite might then precipitate, as suggested by the studies of Yuxue *et al.* (1990) and Song *et al.* (2014). Thus the relatively extreme LREE fractionation of the sample from Kumbel, and to a lesser extent Sanford and Emerald, might also represent such an example, but we lack details in regards to the sampling to evaluate this further. We can note however, that the profiles and the limited fractionation in most sites suggest that this is not a relevant process for the samples in this study.

Present in the CN-REE patterns of scheelite reported here and in several other studies (e.g., Ghaderi *et al.* 1999; Brugger *et al.* 2000*b*; Dostal *et al.* 2009) are those with a concave pattern with a shift in the local maximum from MREE to HREE. Whereas this feature is most common in metamorphic sites (Fig. 3.9C, F, G, J; also those found in literature (as noted above), it also is present in a lesser extent in the magmatic (Fig. 3.10Q) and hydrothermal (Fig. 3.11A) sites. This shift in the local maximum is documented in luminescence spectral data (Uspensky et al. 1998), but not adequately addressed in the literature. As REE^{3+} substitution is associated with the Ca^{2+} site, a minor distortion may occur resulting in a decrease of the $^{[8]}Ca^{2+}$ site (i.e., 1.12 Å → 1.00 Å), effectively shifting the local maximum in CN-REE profiles from Pr-Nd to Er - as summarized in theoretical CN-REE plots in Figure 3.14. Although the patterns observed in our samples fit the latter, there is no known reason as to why the metamorphic scheelites should have a preference for having distorted $^{[8]}Ca^{2+}$ sites. In this regard, two points are noted. Firstly, while samples showing these concave patterns have among the highest ΣREE, this is not always true. Thus whereas Zinnwald-Cínovec scheelite has an elevated ΣREE, it is LREE enriched and fractionated. Secondly, the extensive replacement Ca^{2+} for Sr^{2+} may be linked to site distortions owing to the differences in their ionic radii ($^{[8]}r Ca^{2+}$ = 1.12 Å *versus* $^{[8]}r Sr^{2+}$ = 1.26 Å; Shannon 1976), it might be expected that scheelites with the highest Sr contents might be the most affected. In fact the two samples with the highest Sr do not show such patterns (Figs. 3.4, 3.9A, I). Given that the other trace elements in any significant abundance do not substitute in the $^{[8]}Ca^{2+}$ site, they are not considered further. Thus the present data does not provide further insight into either the nature of the concave patterns or the reason for the shift in the maximum in CN-REE profiles.

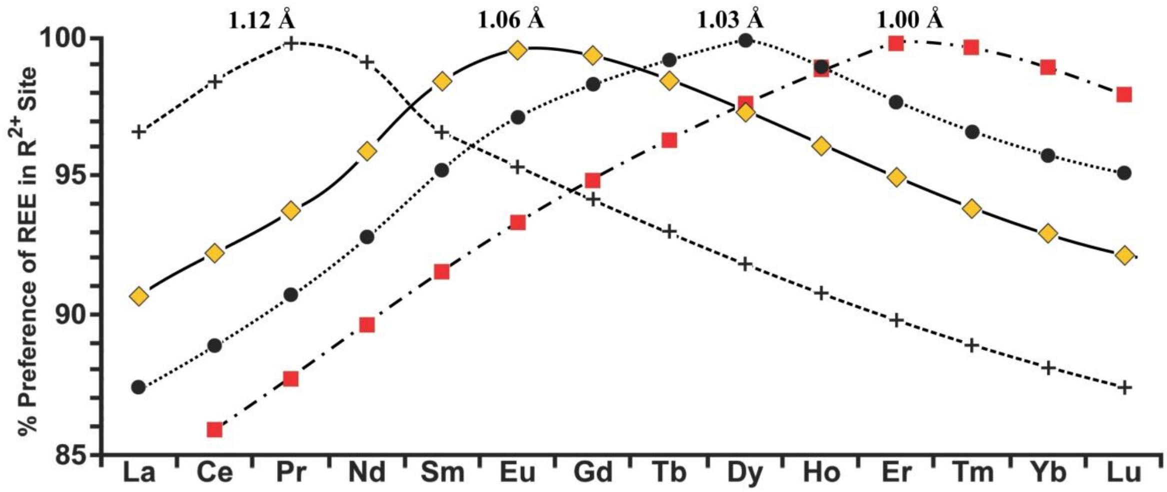

Figure 3.3. A series of theoretical chondrite-normalized (CN) rare-earth element (REE) profiles based on the ideal site substitution of $^{[8]}rCa^{2+}$ for another cation within scheelite ($^{[8]}rCa^{2+}$ = 1.12 Å; Shannon 1976). Chondrite values are after Sun and McDonough (1989). Note that the potential decrease of the $^{[8]}Ca^{2+}$ site size, from 1.12 to 1.00 Å, due to substitutions in scheelite which would shift the resulting CN-REE pattern from light REE towards heavy REE; the inverse would also be applicable (*e.g.* site size increase leading to a shift from HREE to LREE).

3.5.2.5.3. Nature and implications of the Eu anomalies

Europium substitutes for Ca^{2+} in many minerals and scheelite is no exception where either Eu^{2+} or Eu^{3+} are substituted in the [8]-coordinated site (i.e., Ca^{2+}). Of particular relevance however is that there is a redox control as to which valence is preferred, that is Eu^{2+}or Eu^{3+}, which is based on charge and ionic radii considerations. Thus even though Eu^{3+} is favoured, based on its ionic radius ($^{[8]}rCa^{2+}$ = 1.12 Å *versus* $^{[8]}rEu^{3+}$ = 1.066 Å *or* $^{[8]}rEu^{2+}$ = 1.25 Å; Shannon 1976), in fact it is Eu^{2+} that has a higher compatibility over Eu^{3+} due to charge-balance constraints (Blundy & Wood 1994). These latter effects combine to generate enrichment of Eu^{2+} over the inferred abundance of Eu^{3+}, as indicated by its neighbouring REE, these being Sm and Gd, and the ratio is referred to, as noted previously, as the Eu anomaly (here Eu_A). This feature of Eu is of particular use in ore systems as it is used to estimate the redox conditions of ore-forming fluids (Ghaderi *et al.* 1999; Brugger *et al.* 2000*b*, 2002, 2008). In general and as noted repeatedly in the samples analysed in this study, the Eu_A in scheelite is consistent throughout a sample or site (Fig. 3.8). Brugger *et al.* (2008) suggested that a change in Eu_A, which can in part relate to varying oxidation state, can be explained by a drop in pH, which affects the solubility of CO_2 that is common particularly in metamorphic scheelite deposit settings (Bierlein & Crowe 2000; Goldfarb *et al.* 2005; Bodnar *et al.* 2014) or by the onset of fluid-rock interaction. The above discussion provides the basis of using the calculated Eu_A values of scheelite as a proxy for relative oxidation states of the W-bearing fluids (*e,g.*, Guion *et al.* 1985; Ghaderi *et al* 1999). The results of these calculated values are summarized in Figure 3.8 where it can be seen that metamorphic settings in general have higher values and thus represent more reduced settings. In contrast the magmatic- and hydrothermal-related settings have Eu_A <1 or are variable with the greisen and porphyry type also having some with Eu_A >1. Notably the skarn settings, which are relatively oxidized compared to the latter two intrusion-related settings (Seedorff *et al.* 2005; Meinert *et al.* 2005), have Eu_A <1 and are consistently the most oxidized settings. These conclusions based on the Eu_A values agree with the inferences made based on both the higher Mo contents and lower As, both of these being redox sensitive as previously discussed.

Another way of examining the Eu_A is to assess it compared to the value of a neighbouring REE such as Sm, which is shown in Figure 3.15 as a plot of Eu_A *versus* Sm. In this plot the Eu_A is used to reflect redox state, whereas the amount of Sm is a measure of the amount of REE substitution for Ca^{2+}. As expected from the above, many of the scheelite samples from non-metamorphic settings have Eu_A values <1, but there are also those that fall above which, as noted before, indicate a variable redox state in the fluid for these ore systems. There is also a drop in the Eu_A values as Sm values increase which is due to the development of the Eu_A value in part a function of the evolution of the system, which fractionates and depletes itself in the REEs. This plot therefore reflects the influence of paragenetically overlapping phases in the ore systems.

The metamorphic-related scheelites define two trends in Figure 3.15, one with a steep negative slope of about 1:1 and a second shallower slope where changing Sm does not seem to affect the Eu_A. For those samples with the largest variation in Eu_A, this is due to the internal fractionation of the REEs (e.g., Fig. 3.9A, B, E) and the incremental drop in the other REEs, that is Eu_N is actually constant. This also means that Eu^{2+} is being excluded during this fractionation and implies, therefore, that the other REEs must be removed from the closed system by

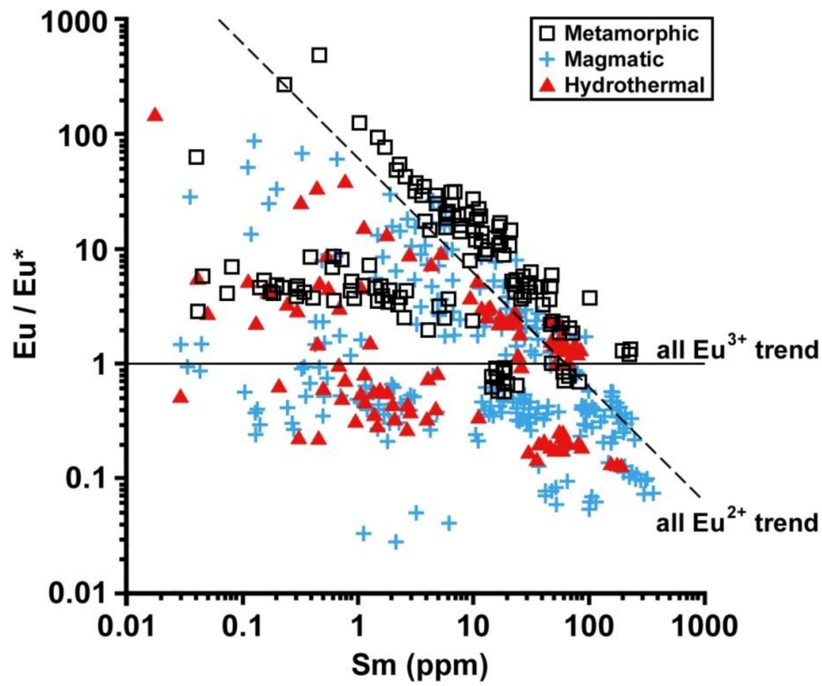

Figure 3.4. A binary plot of Eu/Eu* ratios *versus* Sm concentrations in scheelite analysed in this study. The high Sm concentrations indicate large amounts of REE^{3+} substitution into scheelite, whereas high Eu/Eu* values indicate crystallisation from a reduced fluid and/or a fluid with a positive Eu anomaly. The significance of the horizontal line at Eu/Eu* = 1, due to cystallisation from an oxidized (i.e., Eu as Eu^{3+}), and inclined line, where Eu^{2+} dominates, is discussed in the text.

cogenetic phases, which cannot accommodate Eu^{2+} in its reduced state. An additional aspect of this plot is that if all of these scheelites had crystallized from fluids with the same initial Eu_A, they would all define the same straight line having a negative slope that depended on the original Eu_A value. That this is not the case indicates that a variable Eu_A characterized these systems.

3.5.3. Potential of scheelite as an ore deposit discriminator

The different ways of assessing the data, as presented above, have application for varied end purposes, with three that are relevant here being an improved understanding ore-forming processes (i.e., reduced *versus* oxidized), discriminating ore deposit settings (i.e., magmatic and non-magmatic) and application for exploration as a RIM. Since the second of these dictates its potential application as a RIM, we do not focus on this aspect since it will follow from our conclusion that scheelite has the potential to discriminate ore deposit settings. This is not however, the first attempt to use scheelite chemistry to discriminate an ore deposit setting or the source of the mineralizing fluid (e.g., Cottrant 1981; Raimbault 1985; Yuxue *et al.* 1990; Brugger *et al.* 2000*b*; Song *et al.* 2014), but it is the first comprehensive account as the previous studies focused singular settings or locales. Also of relevance in the contest of this work the analytical methods to be applied so that the maximum amount of information can be extracted in the most efficient way both fiscally (i.e., cheaply) and in terms of time (i.e., quickly). This aspect is discussed at the end of this section.

The use of CL imaging, as noted above, provides insight into the growth history of scheelite and based on our findings (Poulin *et al.* 2016) provides some indication of ore deposit affinity. Thus scheelites from magmatic deposits often show more zoning than metamorphic, which mimics that found for magmatic-related vein quartz (e.g., Boggs *et al.* 2002; Götze *et al.* 2005; Rusk 2012). In part the presence of the CL zoning reflects the trace metal content of the host phase, which in this study likely reflects Mo in the scheelite structure. Thus it is an indirect indication of the redox sensitive nature of the setting.

The use of the redox sensitive indicator elements, Eu, As, and Mo, in addition to Sr, provides the means to discriminate the two main settings for which samples have been studied. The most effective plots use the Eu_A values *versus* Sr and Mo with As less discriminating (Fig. 3.16A, B, C). Furthermore the use of the Mo/Sr ratio *versus* Eu_A appears to provide the most discriminating plot (Fig. 3.16D). As alluded to above, it is important to note that the discrimination of ore settings using these elements is a combination of processes and not a singular factor. Thus, both As and Mo reflect a combination of redox and crystal-chemical controls, as shown in Figure 3.16 using Eu_A as a proxy for this parameter. Thus in the metamorphic settings As is reduced (As^{3+}) and is not easily incorporated into the W^{6+} site, thus even though the environment may be As rich (e.g., Bierlein & Crowe 2000; Goldfarb *et al.* 2005), its preferred valence as As^{3+} inhibits its substitution into scheelite, whereas for the magmatic settings the As^{5+} readily fits into the W^{6+} site. Similarly for Mo, the oxidized Mo^{6+}, is the preferred state of Mo in magmatic settings, is reflected in the relative enrichment of Mo in scheelite from such settings even though it occurs as Mo^{4+} in molybdenite due to coupled oxidation-reduction reactions in porphyry and skarn type deposits (Seedorff *et al.* 2005; Meinert *et al.* 2005). As for Sr, although not redox sensitive its enrichment and depletion in scheelite relates to the nature of ore-fluid generation. Thus, in metamorphic settings its release from mixed or singular lithologies of either metasedimentary or volcanic (i.e., felsic to mafic) rocks is suggested to account for the Sr variable enrichment in scheelite for metamorphic settings. In contrast, magmatic scheelite deposits owe their origin to the release of W-bearing fluids from evolved or highly fractionated felsic magmas which by their very nature are Sr depleted. As discussed above, the CN-REE patterns for scheelite from magmatic settings is also considered in part to reflect the REE chemistry of the progenitor magmas.

An ore deposit type not examined in this study, but of global significance from both the academic and exploration industry perspective, is the Reduced Intrusion Related Gold (RIRG) deposit type, as discussed in detail by Hart (2007). This deposit style is associated with both reduced intrusions and variably oxidized and reduced host rocks, which includes both carbon-bearing dark metasiltstones and platform carbonates. Deposit style vary with greisens, veins, and skarn types and are known to occur with a variety of metal associations – Au, Cu, W, Ag, Bi, Te, As, Pb, Sb, and Zn. The application of scheelite chemistry to this setting would prove interesting given the overlap of its features with the metamorphic- and magmatic-types used in this study. Based on the current data set, these scheelites would be expected to show depletion in As and Mo, enrichment in Sr, elevated Eu_A and magmatic-type REE patterns.

The $\delta^{18}O$ values of minerals can prove invaluable for determining the source of fluids in ore-forming settings. The application of such analysis to scheelite in this study has met with equivocal results such that it has not been possible to use the calculated $\delta^{18}O_{H2O}$ data in the same manner as the elemental analyses and make inferences about ore deposit settings even though there should be measured differences for metamorphic and magmatic settings (Taylor 1979; Sheppard 1986). The results have however highlighted an important feature, this being that most of the data are explained by either fluid mixing, Rayleigh fractionation, or some combination of the two. That fluid mixing occurs is well demonstrated where fluid inclusion studies have been done, as for example in high level vein systems of magmatic affinity (e.g., Shelton *et al.* 1987). As discussed before, this is unlikely to be the case for metamorphic settings and instead a Rayleigh fractionation model might be invoked. Clearly more detailed work is needed to resolve

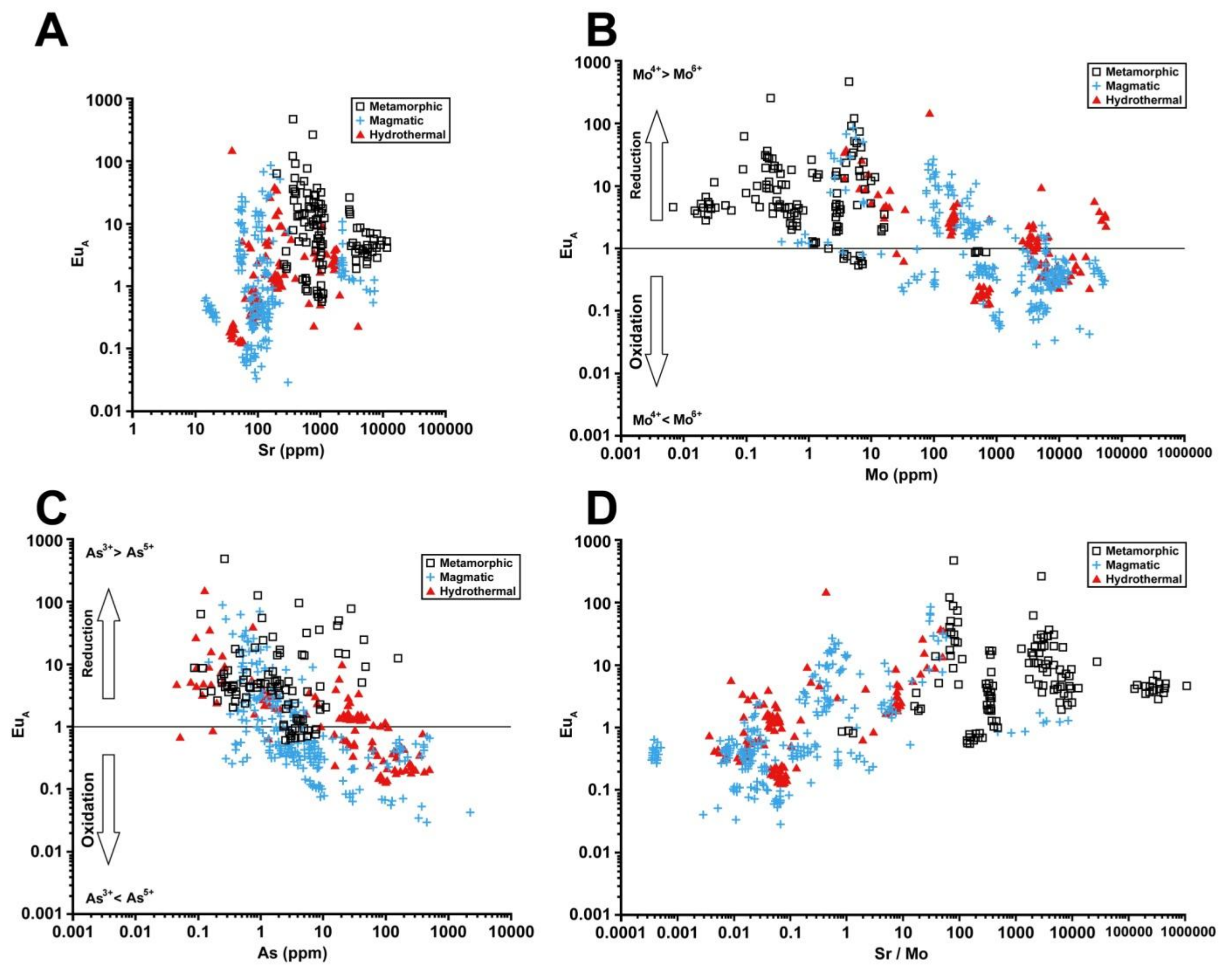

Figure 3.5. Binary plots summarizing the Eu anomaly (Eu$_A$, defined as Eu/Eu*), in scheelite analysed from various deposits. Note that the data have been grouped by deposit and fluid type. The binary plots include A) Eu$_A$ *versus* Sr , B) Eu$_A$ *versus* Mo, C) Eu$_A$ *versus* As and D) Eu$_A$ *versus* Mo/Sr. Furthermore, the oxidation *versus* reduction shown is based on the level of Eu enrichment (i.e. Eu^{2+}; reduced) and depletion (Eu^{3+}; oxidation). In addition, increasing Mo and As concentrations within scheelite suggests they formed from fluids where both Mo and As was present in their oxidized state (Mo^{6+} and As^{5+}), in the case of Mo this promotes the complete solid solution between Mo^{6+} and W^{6+}.

this problem with *in situ* SIMS analysis probably the method to most likely address this outstanding problem given its capacity to analyse at a micro-scale.

The analytical protocol to be used is in part dependent on the facilities accessible and here we focus only on the analysis of the important elements so far identified and discussed, namely the REEs, As, Sr, and Mo. Regardless of the analytical method used, the scheelite should be prepared as grain mounts in epoxy pucks, with 10s of grains mounted per puck, and ground down to a high-quality polish (0.5 μm paste). Subsequently, the scheelite can be analysed using the LA-ICP-MS method to provide the most complete dataset. Most labs should be able to generate a few hundred spot analyses per day with processing done independent of analysis time. Where access to this instrument is not possible, then an electron microprobe operating in wave-length spectrometer (WDS) mode can provide low detection limit resolution needed for the As, Sr and Mo (100s to 500 ppm MDL) which together will permit discrimination of the scheelite. Lastly, the use of SEM-EDS system, which generally has a detection of about 1000 ppm, only be able to detect Mo at levels to indicate a magmatic affinity for the scheelite. Thus, whereas the latter two methods might be used to initially assess deposit discrimination, the LA-ICP-MS offers the best means to fully characterize scheelite.

3.6. Conclusions

The first detailed chemical study of scheelite from a range of deposit settings using *in situ* LA-ICP-MS analysis has provided for the first time the basis for assessing this economically important mineral phase as a resistant indicator mineral (RIM) indicative of certain ore deposit types. Scheelite has long been known to have the physical attributes of other RIM phases, but the chemical database to assess it was lacking. The results presented here indicate that the redox sensitive elements Eu (i.e., as Eu_A), Mo, and As, in addition to Sr, provide to be useful and when combined these elements provide insight in to the nature of both the ore environment and the mineralizing fluid. In particular a plot of Eu_A *versus* Mo/Sr can be used to discriminate between metamorphic and magmatic settings. An important outcome of this study is that due to the redox sensitive nature of the elements, their enrichment or depletion need not reflect that of the host environment and As is the best example of this – enriched in the host rock (i.e., metasedimentary rocks), but depleted in the scheelite.

While this study has proven to be successful, it is considered only as providing the initial insights and further work is needed before the potential of scheelite in the context of providing insight into ore environments, processes and as an ore discriminator can be fully appreciated. Therefore further work should address the following:

- A larger database of deposits that would also include the reduced intrusion Related Gold (RIRG) settings, which contain scheelite and for which there is apparent overlap in geochemical signature (lithogeochemistry, isotopes, fluid inclusions);
- Detailed studies at representative single deposit settings to assess the variation at this scale and through a paragenesis;
- Integration of LA-ICP-MS, CL and *in situ* $\delta^{18}O$ analysis using SIMS to resolve the issue of the calculated $\delta^{18}O_{H2O}$ variability;
- Where the valence of some elements, such as Mn is not constrained, a better understanding of how it fits into the scheelite structure will provide a better basis for interpreting its chemistry.

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Appendix A: Summary of relevant geologic information for the scheelite samples used in this study, as compiled from the literature.

TABLE A1. Abbreviations used in TABLE A2.

Geologic age abbreviations and prefixes							
ARCH	Archean	DEV	Devonian	JUR	Jurassic	MIO	Miocene
CARB	Carboniferious	E	Early	L	Late	OLIGO	Oligocene
CRET	Cretaceous	EO	Eocene	M	Middle	PALEO	Paleocene
Abbreviations for mineral names[1]							
Ab	Albite	Di	Diopside	Mgt	Magnetite	Scl	Scheelite
Amp	Amphibole*	Dol	Dolomite	Mlb	Molybdenite	Sd	Siderite
Anh	Anhydrite	Ep	Epidote	Ms	Muscovite	Sp	Sphalerite
Ank	Ankerite	Fbr	Ferberite	Or	Orthoclase	Td	Tetrahedrite
Ap	Apatite*	Fl	Fluorite	Pl	Plagioclase*	Tn	Tennantite
Apy	Arsenopyrite	Fo	Forsterite	Po	Pyrrhotite	Toz	Topaz
Brl	Beryl	Gn	Galena	Pwl	Powellite	Ttn	Titanite
Bt	Biotite*	Grt	Garnet*	Px	Pyroxene*	Tur	Tourmaline*
Cal	Calcite	Hbl	Hornblende*	Py	Pyrite	Ves	Vesuvianite
Chl	Chlorite*	Hem	Hematite	Qtz	Quartz	Wf	Wolframite*
Cp	Chalcopyrite	Ilm	Ilmenite	Rds	Rhodochrosite	Wo	Wollastonite
Cst	Cassiterite	Kfs	K-feldspar	Rt	Rutile	Znw	Zinnwaldite
Abbreviations for rock names and types							
And	Andesite	D	Diorite	Gwke	Greywacke	Phy	Phylite
Arg	Argillite	Dol	Dolomite	Hfls	Hornfelds	Qzt	Quartzite
Arn	Arenite	Felds	Feldspathic	Ls	Limestone	Rhy	Rhyolite
BIF	Banded Iron Fm	Gfls	Granofelds	Mdst	Mudstone	Seds	Sediments
Bx	Breccia	Gnt	Garnetite	Mrb	Marble	Shl	Shale
Carb	Carbonate	Gr	Granite	Mz	Monzonite	Sltst	Siltstone
Cgl	Conglomerate	Grd	Granodiorite	Mzd	Monzodiorite	Ss	Sandstone
Chemical symbols							
Ag	Silver	Cd	Cadmium	Mo	Molybdenum	W	Tungsten
As	Arsenic	Cu	Copper	Pb	Lead	Zn	Zinc
Au	Gold	Fe	Iron	Pt	Platinum		
Be	Beryllium	Li	Lithium	Si	Silicon		
Bi	Bismuth	Ni	Nickle	Sn	Tin		

[1]Mineral abbreviations are those recommended by Kretz (1983) and Spear (1993), with, in addition: wolframite = Wf, zinnwaldite = Znw. Names shown with an asterisk refer to a series/group of minerals, *i.e.*, they are not names of a single mineral species.

TABLE A2. Summary of relevant geologic information for the scheelite samples used in this study.

Sample #	Deposit[1]	Country	Commodity[2]	Age of Mineralization[3]	Type of Mineralization
11-MPB-SB	Sisson W-Mo Deposit (Sisson Brook) *(D)*	NB, Canada	W-Cu-Mo	LDEV* (379 Ma)	Porphyry-related W-Mo stockwork
C1012 / CMN2317	Moose River *(D)*	NS, Canada	Au (W-Pt)	EDEV (408 – 380 Ma)	Turbidite-hosted Au veins
C1661	Little Long Lac *(D)*	ON, Canada	Au-Ag (W)	ARCH*	Orogenic lode Au?
C1675	Delnite *(D)*	ON, Canada	Au-Ag	ARCH	Orogenic lode Au
C1759 / CMN53665	Hollinger *(D)*	ON, Canada	Au (W)	LARCH* (2617 ± 15 Ma)	Greenstone-hosted Qtz-Carb vein?
C1820	Rocher Déboulé *(D)*	B.C., Canada	Cu-Ag (Au-W)	LCRET*	Porphyry Cu-Au?
C1823	Emerald *(D)*	BC, Canada	W-Mo (Au-Pb-Zn)	CRET	W exoskarn / stratabound Pb-Zn?
CMN1194	Kalzas (Flo Property) *(O)*	YT, Canada	W (Sn)	LCRET* (90 – 95 Ma)	Porphyry-style sheeted Wf veins
CMN1684	NUG-4 Claim (Quick and Easy) *(O)*	NWT, Canada	Au-W (Zn-Ni-Bi)	LDEV	Qtz-Scl vein?
CMN40242	Crane *(O)*	ON, Canada	W (Au-Mo)	LARCH (2680 Ma)	Greenstone-hosted Qtz-Carb vein?
CMN40248	Flat River (M.B. Prospect) *(O)*	NWT, Canada	W	LCRET* (90 – 92 Ma)	W skarn?
CMN40249	Dublin Gulch (Eagle Zone?) *(D)*	YT, Canada	Au (W)	LCRET* (92.8 ± 0.5 Ma)	Intrusion-related Au veins (porphyry Au)
CMN40252	Darwin *(D)*	California, USA	W (Pb-Zn-Ag)	MJUR* (174 Ma)	Skarn? / Carb-hosted Pb-Zn-Ag deposit?
CMN40254	Tulare *(O)*	California, USA	W	LCRET*	W skarn???
CMN40266	Traversella *(D)*	Italy	Cu-Fe (W)	OLIGO* (30 ± 5 Ma)	Fe exoskarn
CMN40273	Dae Hwa (Taewha) *(D)*	South Korea	W-Mo	LCRET (82 ± 2 Ma)	W-Mo stockwork
CMN40275	San Alberto *(D)*	Mexico	W (Cu)	PALEO (56.4 Ma)	W skarn
CMN40276	Guadalupana *(O)*	Sonora, Mexico	Ag-Au	EO?	Scl skarn?
CMN40278	A.M. Berges W-Prospect *(O)*	Mexico	Ag (Pb-Zn-Au)	MIO*	Stockwork / vein???
CMN40286	Hermosillo *(D)*	Mexico	W	PALEO*	W skarn?

[1] Alternative names in ( ); *(D)* Denotes deposit and occurrence *(O)*.
[2] Metals and minerals are generally listed in approximate decreasing order of abundance (some may be sub-equal in abundance); metals and minerals in parentheses are minor; paragenetic sequences have been combined for simplicity.
[3] In some instances the age of mineralization is related to the age of associated magmatism*.

(continued on next page)

TABLE A2. *(continued)*

Deposit	Host Rock(s)	Intrusion Type	Alteration	Principal Mineral Assemblages[4]	References
Sisson W-Mo Deposit	Meta-gabbro / volcanics / Seds	Gr	Potassic, sericitic, chloritic	Qtz-Scl-Mlb-Hbl-Bt-Mgt-Ab-Po (Wf-Py-Cp)	Nast and William-Jones (1991); Bustard *et al.* (2013)
Moose River	Qzt, Arg, slate	Gr-Grd	Sericitic, carbonic, silicic	Qtz-Ank-Cal-Dol-Chl-Bt-Ms-Scl (Apy-Po-Cp-Gn-Mlb-Au)	Mulligan (1984); Hudgins (1996); Sangster and Smith (2007)
Little Long Lac	Felds-Qzt	D	Vein selvage (Silicic, sericitic)	Qtz-Apy-Cp-Tur (Gn-Au-Scl-Po)	Bruce and Samuel (1937); Horwood (1948a); Ferguson *et al.* (1971)
Delnite	Komatiites, tholeiitic basalts	n.d.	Carbonic	Qtz-Cal-Apy-Py-Tur (Au-Scl)	Taylor (1948); Ferguson *et al.* (1971)
Hollinger	Tholeiitic basalts, Carb	Grd	Vein selvage (Fe-carbonic, sericitic)	Qtz-Scl-Ank-Py-Ab-Tur (Au-Ap-Cp-Sp-Gn-Po)	Allen and Folinsbee (1944); Jones (1948); Wood (1991)
Rocher Déboulé	D, Qzt, Mdst, Sltst	Grd / D	Vein selvage (phyllic, sericitic)	Hlb-Qtz (Pl-Ap-Mgt-Scl-Tur-Fbr-Mlb)	Sutherland Brown (1960); Burgonyne and Kikauka (2007)
Emerald	Ls, Arg (Shl?)	Gr	Sericitic, chloritic, silicic	Px-Grt-Amp (Bt-Ep-Pl-Ves-Scl-Pwl-Wf-Mlb-Po-Py-Cp)	Ball (1954); Mulligan (1984); Cathro and Lefebure (2000)
Kalzas	Clastic metaSeds	Gr	Zoned (potassic, Qtz-Tur-Ms, Qtz-Ms-Py)	Qtz-Tur-Wf-Py-Ms-Cst (Or-Ap-Mlb-Scl-Apy)	Lynch (1989); Carlson (2002)
NUG-4 Claim	Bt-Mz, Sltst, Arn, chert, Ls, Hfls	Bt-Mz	Contact aureole (sericitic)	Qtz-Scl-Cal-Wf-Dol (Po-Py-Apy)	Gordey and Anderson (1993); Downie (2004)
Crane	Cgl-schist, Bt-Chl-schist	Grd	n.d.	Qtz-Scl-Mlb-Py (Ms-Pl-Cal-Au)	McCartney (1943); Nickel (1952)
Flat River	Ls, Arg	Qtz-Mz	Retrograde (Hbl-Bt)	Px-Grt-Ves-Scl-Chl-Qtz-Cal (Wo-Cp)	Blusson (1968); Mulligan (1984); Burt (1986)
Dublin Gulch	Qzt, Phy, schist (Carb)	Bt-Grd	Contact aureole (Bt-Qtz, sericitic, chloritic)	Qtz-Kfs-Ab-Cal-Ms-Chl-Scl-Po-Apy-Py	Sinclair (1986); Brown *et al.* (2002); Maloof *et al.* (2001)
Darwin	Ls, Ss, Hfls	n.d.	n.d.	Ves-Grt-Wo-Di-Ep-Scl-Gn-Sp-Py-Cp-Cal	Hall and Mackevett (1962); Newberry *et al.* (1991)
Tulare	Dol, Ls	Grd	Contact aureole	Grt-Qtz-Scl (Cal-Py-Mlb-Pwl)	Krauskopf (1953)
Traversella	Gneiss, eclogitic micaschists, Dol	Mz-D	Zoned (Grt, Px, Cal)	Cal-Dol-Scl-Mgt-Cp-Fo-Px-Chl-Wo-Di	Dubru *et al.* (1988); Vander Auwera and Andre (1991); Vander Auwera and Verkaeren (1993)
Dae Hwa	Bt-Gr-gneiss	Gr	Contact aureole (sericitic, chloritic)	Qtz-Ms-Brl-Mlb-Cst-Wf-Scl-Fl (Py-Po-Cp)	Bancroft (1979); So *et al.* (1983); Sheldon *et al.* (1987)
San Alberto	Ls	Qtz-Mzd	Contract aureole (silicic, propylitic, argillic)	Qtz-Cal-Grt-Amp-Scl-Ep	Anstett *et al.* (1985); Mead *et al.* (1988)
Guadalupana	Rhy, And, Tuff, Shl	n.d.	n.d.	Qtz-Ves-Tur-Ep-Scl-Ap-Pwl-Ttn	Trask and Cabo (1948); Panczner (1987); Clark and Fitch (2009)
A.M. Berges W-Prospect	Ss (Shl, Sltst, Carb)	Gr / Grd	n.d.	Qtz-Cal-Py-Sp-Gn-Cp	Lopez *et al.* (2012)
Hermosillo	Ls, Shl	Grd	n.d.	Qtz-Cal-Grt-Ep-Scl	Mead *et al.* (1988)

[4] Abbreviations are those recommended by Kretz (1983) and Spear (1993), and are summarized in Table A1. In cases of districts, not all minerals may be present in a given deposit; n.d. = no data.

(continued on next page)

TABLE A2. *(continued)*

Sample #	Deposit[1]	Country	Commodity[2]	Age of Mineralization[3]	Type of Mineralization
CMN50171	Britannia Mine *(D)*	BC, Canada	Cu-Zn-Pb (Ag-Cd-Au)	CRET*	Noranda / Kuroko massive sulphide
CMN52204	Ortiz Mine (Cunningham Hill) *(D)*	New Mexico, USA	Au-Ag (W-Cu)	OLIGO (≈ 28 Ma)	Breccia Au?
CMN53448	Kumbel (Kara-Urkurt) *(D)*	Kyrgyzstan	W-Cu-Mo (Au)	CARB* (≈ 310 – 312 Ma)	Oxidized Scl skarn
CMN55153	Morro Velho *(D)*	Brazil	Au	LARCH (2672 ± 14 Ma)	Orogenic lode Au
CMN80388	Jardine *(D)*	Montana, USA	Au (As-W)	ARCH*	Orogenic lode Au?
CMN80801	Yongwol (Yeongwol-gun) *(D)*	South Korea	W-Mo	LCRET*	Mo stockwork?
CMN80802	Sangdong *(D)*	South Korea	W-Mo (Bi-Au)	LCRET (84 ± 3 Ma)	Scl exoskarn
CMN85546	Sanford *(O)*	Maine, USA	Mo-W	CARB* (322 ± 12 Ma)	Mo skarn?
CMN85817	Carrock Fell *(D)*	United Kingdom	W (Mo)	MDEV (386 ± 6 Ma)	Qtz-Wf greisen veins
CMN86063	Sigma *(D)*	QC, Canada	Au	ARCH	Greenstone-hosted Qtz-Carb vein
CMNXXXX	Huya *(D)*	China	W-Sn (Be)	EJUR (182 ± 9.2 Ma)	W-Sn-Be stockwork
CXXXX	Cantung *(D)*	NWT, Canada	W	LCRET (91.4 Ma)	Scl (Po) exoskarn
M1020	Castañeda de Llamuco Mine *(D)*	Chile	Cu (W)	CRET*	Cu-W breccia pipe?
M6258	Tungstar *(D)*	California, USA	W (Si)	CRET*	Endoskarn
M6348 / CMN82045	Zinnwald – Cínovec *(D)*	Czech Republic	Sn-W-Li	ECARB – DEV* (330 – 395 Ma)	Sn greisen veins
M6-5B	The Ovens *(D)*	NS, Canada	Au	EDEV (407 ± 4 Ma)	Turbidite-hosted Au veins
M6616	Barewood *(D)*	New Zealand	Au (W)	ECRET (125 Ma)	Orogenic Au
M6917	Kovárna Mine (Obří dul, Riesengrund) *(D)*	Czech Republic	Fe-As-Cu (W)	CARB* (304 – 329 Ma)	Polymetallic Qtz veins? / skarn?
ME736	Mackenzie Mine *(D)*	ON, Canada	Au-Ag	LARCH* (2720 ± 3 Ma)	Greenstone-hosted Qtz-Carb vein?
ME747	Silverton (Sunnyside Mine?) *(D)*	Colorado, USA	Zn-Pb-Cu (Ag-Au)	MIO (13 – 16.6 Ma)	Polymetallic Ag-Pb-Zn ± Au veins

[1] Alternative names in ( ); *(D)* Denotes deposit and occurrence *(O)*.
[2] Metals and minerals are generally listed in approximate decreasing order of abundance (some may be sub-equal in abundance); metals and minerals in parentheses are minor; paragenetic sequences have been combined for simplicity.
[3] In some instances the age of mineralization is related to the age of associated magmatism*.

(continued on next page)

TABLE A2. *(continued)*

Deposit	Host Rock(s)	Intrusion Type	Alteration	Principal Mineral Assemblages[4]	References
Britannia Mine	Chl-Ms-schist, slate	Qtz-D / Qtz-Mzd	Chloritic, sericitic	Qtz-Py-Ms-Chl-Cp-Sph (Anh-Gn-Tn-Td)	Schofield (1926); Irvine (1948); Payne *et al.* (1980)
Ortiz Mine	Bx (Qzt, Ss, Shl)	Mz / Mzd	n.d.	Qtz-Py-Mgt-Cal-Sd-Cp-Au-Scl	Maynard (1995)
Kumbel	Ls, Ss	Mz / Mzd	Propylitic, phyllic	Qtz-Cal-Amp-Px-Cal-Grt-Scl-Cp-Ves-Hem-Mgt-Py-Mlb-Brl-Ap	Rabchevsky (1988); Soloviev (1994, 2015)
Morro Velho	Fe-Dol (slate, metavolcanics)	Tonalite-Grd	Carbonic, sericitic, chloritic, silicic	Qtz-Dol-Sd-Cal-Ms-Chl-Ab (Ep-Rt-Ap-Ilm-Mgt-Py-Tur-Scl)	Bernasconi (1985); Lobato *et al.* (2007); Vial *et al.* (2007)
Jardine	Metaturbidite (metapelite, BIF)	Qtz-Mz	Silicic	Qtz-Hbl-Grt-Bt-Apy-Po-Cp (Gn-Au-Scl)	Fraser *et al.* (1969); Smith (1996)
Yongwol	Shl, Ls	Mz	Potassic, silicic	Qtz-Dol-Scl-Mlb-Py-Wf-Di-Grt-Hbl-Fl-Ap	Laznicka (2006)
Sangdong	Ls (Hfls, Ss, Shl)	Gr	Zoned (Qtz-Ms, Amp, Px-Grt)	Qtz-Bt-Ms-Scl (Hbl-Grt-Di-Wf-Mlb-Fl)	Farrar *et al.* (1978); Laznicka (2006)
Sanford	Gfls (Mrb)	Bt-Gr	n.d.	Ves-Fl-Sp-Cal-Di-Grt-Qtz (Mlb-Scl-Pwl-Ttn)	Leavitt and Leavitt (1993)
Carrock Fell	Gnt, gabbro, slate (Hfls?)	Gr	Qtz-Ms-Ap	Qtz-Ms-Ap-Wf-Scl (Py-Apy-Po-Fl-Dol-Cal)	Appleton and Wadge (1976); Shepherd and Waters (1984); Ball *et al.* (1985)
Sigma	Calc-alkalic tuffs, tholeiilitc basalts	D	Vein selvage (carbonic, sericitic)	Qtz-Tur-Cal-Ms-Chl (Py-Scl-Cp-Au)	Robert and Brown (1986a,b); Olivo *et al.* (2006)
Huya	Phy, Mrb	Qtz-Mz / Mzd	Contact aureole (sericitic)	Qtz-Ms-Tur-Scl-Brl-Cst-Fl-Cal	Cao *et al.* (2002); Liu *et al.* (2007)
Cantung	Ls (Arg, Qzt, Hfls, Mrb)	Bt-Gr	Contact aureole (Grt, Px)	Scl-Po-Cp-Di-Px-Qtz-Amp (Cal-Tur-Ap)	Mathieson and Clark (1984); Laznicka (2006)
Castañeda de Llamuco Mine	And	Gr	Potassic, sericitic, argillic, silicic, propylitic	Qtz-Ms-Scl-Apy-Tur-Py-Cal (Cp-Gn-Wf)	McAllister and Ruiz F. (1948); Sillitoe (1973)
Tungstar	Ls, Hfls, Qtz-D	Qtz-D	n.d.	Grt-Ep-Qtz-Py-Ap-Ttn-Scl	Lemmon (1941); Bateman (1953)
Zinnwald – Cínovec	Greisens, Gnt	Gr	Greisen	Qtz-Cst-Znw-Wf-Scl-Sd-Cal-Toz-Ms-Fl	Durisoval *et al.* (1979); Štemprok (1986); Webster *et al.* (2004)
The Ovens	Slates and metaSs	n.d.	Vein Selvages (carbonic)	Qtz-Cal-Chl-Ab-Ms (Tur-Scl-Po-Py-Apy-Cp-Gn-Mlb-Au)	Sangster and Smith (2007); Kontak *et al.* (2011)
Barewood	MetaGwke	n.d.	Silicic, argillic	Qtz-Scl-Apy (Au-Py-Cp-Sp-Gn)	MacKenzie and Craw (1993); Pitcairn *et al.* (2006)
Kovárna Mine	Schist, Qzt, Ls	Bt-Grd	Contact aureole (sericitic)	Qtz-Cal-Po-Fl-Cp-Asp-Mgt (Scl-Py-Gn-Sp-Mlb-Cst-Rt)	Štemprok (1986); Žák, J. and Klomínský (2007); Žák, J. *et al.* (2008)
Mackenzie Mine	Mylonite-D	D / Qtz-D	Carbonic, silicic, sericitic	Qtz-Cal-Ms-Tur-Py-Apy-Ank (Au-Scl-Cp-Gn-Sp)	Horwood (1948b); Ferguson *et al.* (1971); Dubé (2004)
Silverton	Qtz-latite, Seds, Bx	Qtz-Mz	Phyllic, sericitic, propylitic	Qtz-Sph-Gn-Py-Rds-Cp-Td-Fl-Cal	Rosenzweig (1957); Casadevall and Ohmoto (1977); Eberl *et al.* (1987)

[4] Abbreviations are those recommended by Kretz (1983) and Spear (1993), and are summarized in Table A1. In cases of districts, not all minerals may be present in a given deposit; n.d. = no data.

Appendix B: Statistical analysis of the major and trace element compositions of the analysed scheelite samples from various deposits, as determined from LA-ICP-MS.

TABLE B1. Sisson W-Mo Deposit, NB, Canada (11-MPB-SB).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	22	≤ LOD	4 (0.2)	2	2 (0.2)
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	2	≤ LOD	97 (9.3)	88	88 (16.7)
Ti	9	≤ LOD	10 (7.9)	3	4 (1.2)
V	61	≤ LOD	7 (0.2)	4	5 (0.2)
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	62	21.0 (0.7)	81.4 (2.7)	40.0	44.4 (1.5)
Fe	15	≤ LOD	174 (17.0)	5	48 (11.9)
Co	1	≤ LOD	2.2 (0.9)	2.2	2.2 (0.9)
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	62	4 (0.2)	11 (0.6)	7	7 (0.3)
Rb	4	≤ LOD	2.2 (0.2)	1.4	1.4 (0.3)
Sr	62	66.3 (1.9)	151.7 (5.4)	140.2	127.4 (4.0)
Y	62	458.0 (13.0)	1575.0 (44.0)	877.0	901.0 (28.0)
Mo	62	1031 (73.0)	10020 (310.0)	7760	6739 (219.1)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	62	614000 (38000)	736000 (49000)	688500	683177 (41710)
La	62	31.4 (0.92)	286.5 (9.30)	166.0	149.9 (4.83)
Ce	62	137.9 (3.80)	996.0 (32.00)	688.5	619.2 (19.94)
Pr	62	28.3 (0.84)	163.1 (5.10)	126.5	113.2 (3.65)
Nd	62	190.3 (5.30)	980.0 (30.00)	676.5	615.0 (19.89)
Sm	62	82.8 (2.30)	348.0 (11.00)	178.5	181.6 (5.80)
Eu	62	7.43 (0.28)	27.26 (0.83)	17.64	16.51 (0.54)
Gd	62	76.7 (2.30)	395.0 (12.00)	170.3	186.7 (5.97)
Tb	62	13.3 (0.40)	65.0 (2.10)	29.2	31.5 (1.00)
Dy	62	92.3 (2.70)	428.0 (15.00)	199.1	212.6 (6.82)
Ho	62	17.6 (0.54)	80.2 (2.20)	38.2	40.4 (1.30)
Er	62	50.3 (1.50)	207.4 (5.50)	107.0	110.9 (3.54)
Tm	62	7.0 (0.21)	24.1 (0.80)	14.6	14.7 (0.47)
Yb	62	38.8 (1.10)	124.3 (3.80)	85.4	82.1 (2.67)
Lu	62	4.2 (0.12)	14.8 (0.48)	9.9	9.6 (0.32)
∑REE + Y	62	1455.5 (9.0)	5306.5 (44.7)	3432.0	3284.8 (31.6)
$(La/Lu)_{CN}$	62	0.56 (0.14)	2.66 (0.95)	1.68	1.61 (0.41)
$(La/Sm)_{CN}$	62	0.16 (0.04)	1.29 (0.31)	0.55	0.55 (0.14)
$(La/Y)_{CN}$	62	0.28 (0.07)	2.52 (0.60)	1.18	1.16 (0.29)
$Eu_A = Eu/Eu^*$	62	0.07 (0.00)	0.58 (0.03)	0.32	0.30 (0.02)
$Ce_A = Ce/Ce^*$	62	0.97 (0.07)	1.16 (0.08)	1.08	1.07 (0.08)

n.d. = not determined

TABLE B2. Moose River, NS, Canada (C1012).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	12	≤ LOD	2 (0.2)	1	1 (0.1)
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	70 (25.0)	70	70 (25.0)
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	4	≤ LOD	4 (0.3)	3	3 (0.3)
Mn	19	6.0 (0.3)	8.8 (0.3)	7.1	7.3 (0.2)
Fe	1	≤ LOD	7 (16.0)	7	7 (16.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	1	≤ LOD	2 (0.4)	2	2 (0.4)
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	19	2 (0.2)	5 (0.4)	4	3 (0.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	19	931.0 (10.0)	1086.0 (13.0)	1012.0	1014.4 (11.5)
Y	19	417.0 (18.0)	767.0 (66.0)	582.7	578.2 (12.5)
Mo	19	6 (0.2)	7 (0.2)	7	6 (0.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	19	685400 (9300)	758200 (7600)	711200	714237 (7526)
La	19	2.0 (0.05)	3.0 (0.12)	2.5	2.5 (0.05)
Ce	19	10.1 (0.16)	16.0 (0.48)	13.4	13.2 (0.20)
Pr	19	2.5 (0.04)	4.0 (0.11)	3.2	3.2 (0.06)
Nd	19	20.7 (0.34)	33.6 (0.69)	25.3	25.5 (0.45)
Sm	19	14.1 (0.21)	23.1 (0.53)	16.7	16.9 (0.35)
Eu	19	5.49 (0.09)	8.36 (0.19)	6.53	6.57 (0.11)
Gd	19	38.0 (0.53)	59.1 (1.60)	46.6	46.8 (0.85)
Tb	19	10.1 (0.11)	14.0 (0.99)	12.3	12.2 (0.23)
Dy	19	101.2 (1.20)	139.4 (9.70)	120.8	118.9 (2.22)
Ho	19	24.3 (0.79)	36.0 (2.40)	30.2	29.6 (0.52)
Er	19	59.8 (2.30)	106.1 (7.60)	82.6	82.4 (1.57)
Tm	19	5.8 (0.25)	12.0 (1.10)	9.0	8.9 (0.21)
Yb	19	22.4 (1.20)	54.1 (6.10)	35.3	35.3 (1.02)
Lu	19	1.6 (0.09)	3.8 (0.35)	2.6	2.6 (0.07)
∑REE + Y	19	805.7 (4.8)	1251.9 (14.4)	991.6	982.8 (3.2)
$(La/Lu)_{CN}$	19	0.07 (0.02)	0.19 (0.06)	0.10	0.10 (0.02)
$(La/Sm)_{CN}$	19	0.08 (0.02)	0.11 (0.02)	0.09	0.09 (0.02)
$(La/Y)_{CN}$	19	0.02 (0.01)	0.05 (0.01)	0.03	0.03 (0.01)
Eu_A = Eu/Eu*	19	0.59 (0.05)	0.78 (0.03)	0.67	0.67 (0.03)
Ce_A = Ce/Ce*	19	0.90 (0.05)	0.96 (0.04)	0.93	0.93 (0.05)

n.d. = not determined

TABLE B3. Little Long Lac, ON, Canada (C1661).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	3	≤ LOD	2.1 (0.2)	1.9	1.8 (0.2)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	5	≤ LOD	3 (0.3)	2	2 (0.4)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	19	5160.0 (170.0)	11480.0 (330.0)	7770.0	7803.7 (228.9)
Y	19	0.6 (0.0)	7.7 (0.2)	2.3	2.8 (0.1)
Mo	0	≤ LOD	≤ LOD	n.d.	n.d.
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	11	≤ LOD	7 (0.4)	2	3 (0.2)
W	19	705000 (44000)	846000 (55000)	789000	776526 (48684)
La	19	0.2 (0.01)	3.9 (0.12)	0.7	0.9 (0.04)
Ce	10	≤ LOD	7.5 (0.20)	1.7	2.4 (0.08)
Pr	14	≤ LOD	0.9 (0.03)	0.2	0.3 (0.01)
Nd	14	≤ LOD	3.6 (0.13)	0.8	1.1 (0.06)
Sm	3	≤ LOD	0.9 (0.07)	0.9	0.8 (0.06)
Eu	18	≤ LOD	1.61 (0.05)	0.34	0.49 (0.02)
Gd	14	≤ LOD	1.3 (0.06)	0.3	0.5 (0.04)
Tb	1	≤ LOD	0.2 (0.01)	0.2	0.2 (0.01)
Dy	7	≤ LOD	1.1 (0.06)	0.5	0.7 (0.04)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	2	≤ LOD	0.5 (0.02)	0.5	0.5 (0.02)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	1	≤ LOD	0.3 (0.03)	0.3	0.3 (0.03)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	19	1.9 (0.1)	29.4 (0.3)	6.8	8.5 (0.1)
$(La/Lu)_{CN}$	19	3.58 (2.08)	13.94 (6.02)	5.29	5.74 (2.78)
$(La/Sm)_{CN}$	19	1.12 (0.40)	3.99 (2.47)	2.21	2.39 (1.07)
$(La/Y)_{CN}$	19	1.43 (0.37)	3.36 (0.82)	1.87	2.05 (0.60)
Eu_A = Eu/Eu*	19	2.83 (1.13)	6.91 (1.89)	4.35	4.48 (0.90)
Ce_A = Ce/Ce*	19	0.84 (0.07)	0.97 (0.14)	0.89	0.89 (0.09)

n.d. = not determined

TABLE B4. Delnite, ON, Canada (C1675).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	1	≤ LOD	2.4 (0.4)	2.4	2.4 (0.4)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	0	≤ LOD	≤ LOD	n.d.	n.d.
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	2	198.8 (3.7)	371.0 (13.0)	284.9	284.9 (8.4)
Y	2	0.6 (0.0)	6.6 (0.9)	3.6	3.6 (0.5)
Mo	0	≤ LOD	≤ LOD	n.d.	n.d.
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	1	≤ LOD	7 (0.5)	7	7 (0.5)
W	2	737500 (8500)	738200 (9400)	737850	737850 (8950)
La	1	≤ LOD	2.4 (0.20)	2.4	2.4 (0.20)
Ce	1	≤ LOD	4.9 (0.49)	4.9	4.9 (0.49)
Pr	1	≤ LOD	0.6 (0.07)	0.6	0.6 (0.07)
Nd	1	≤ LOD	2.6 (0.34)	2.6	2.6 (0.34)
Sm	1	≤ LOD	0.7 (0.13)	0.7	0.7 (0.13)
Eu	2	0.73 (0.03)	1.90 (0.11)	1.31	1.31 (0.07)
Gd	1	≤ LOD	0.7 (0.12)	0.7	0.7 (0.12)
Tb	0	≤ LOD	≤ LOD	n.d.	n.d.
Dy	1	≤ LOD	1.0 (0.15)	1.0	1.0 (0.15)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	1	≤ LOD	0.7 (0.12)	0.7	0.7 (0.12)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	1	≤ LOD	0.9 (0.13)	0.9	0.9 (0.13)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	2	2.1 (0.1)	23.7 (0.7)	12.9	12.9 (0.4)
$(La/Lu)_{CN}$	2	1.72 (0.86)	3.33 (2.05)	2.53	2.53 (1.45)
$(La/Sm)_{CN}$	2	2.15 (1.11)	2.77 (1.83)	2.46	2.46 (1.47)
$(La/Y)_{CN}$	2	2.14 (0.82)	2.45 (1.16)	2.30	2.30 (0.99)
Eu_A = Eu/Eu*	2	7.90 (2.04)	63.62 (34.49)	35.76	35.76 (18.26)
Ce_A = Ce/Ce*	2	0.77 (0.14)	0.93 (0.16)	0.85	0.85 (0.15)

n.d. = not determined

TABLE B5. Hollinger, ON, Canada (C1759).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	34 (7.0)	34	34 (7.0)
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	16	≤ LOD	3.1 (0.3)	1.6	1.9 (0.2)
Fe	3	≤ LOD	9 (2.2)	7	7 (8.9)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	15	≤ LOD	160 (8.9)	18	29 (2.0)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	361.0 (5.6)	1155.0 (23.0)	450.0	507.3 (10.4)
Y	20	6.3 (0.2)	109.1 (2.2)	23.7	34.9 (0.9)
Mo	20	4 (0.1)	12 (0.3)	6	7 (0.3)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	2	≤ LOD	5 (0.7)	3	3 (0.5)
W	20	690000 (11000)	763000 (11000)	741500	736620 (11595)
La	20	4.1 (0.07)	26.6 (0.45)	9.0	10.5 (0.24)
Ce	20	9.0 (0.13)	70.7 (1.10)	22.6	28.0 (0.71)
Pr	20	0.9 (0.03)	12.7 (0.73)	3.8	4.8 (0.14)
Nd	20	2.6 (0.10)	76.0 (3.50)	19.4	25.2 (0.79)
Sm	20	0.5 (0.04)	22.8 (0.88)	5.2	7.1 (0.27)
Eu	20	19.70 (1.00)	64.94 (0.87)	40.52	41.95 (0.83)
Gd	20	0.3 (0.03)	23.9 (0.68)	4.7	6.9 (0.26)
Tb	18	≤ LOD	3.6 (0.10)	0.7	1.1 (0.04)
Dy	20	0.5 (0.04)	23.2 (0.53)	3.9	6.3 (0.20)
Ho	17	≤ LOD	4.2 (0.09)	0.8	1.3 (0.04)
Er	20	0.5 (0.03)	10.7 (0.22)	1.9	2.9 (0.09)
Tm	7	≤ LOD	1.3 (0.03)	0.8	0.8 (0.02)
Yb	20	0.3 (0.03)	9.5 (0.20)	1.4	2.5 (0.09)
Lu	4	≤ LOD	1.3 (0.03)	1.0	1.0 (0.03)
∑REE + Y	20	70.0 (0.9)	411.3 (5.2)	138.5	173.8 (1.6)
$(La/Lu)_{CN}$	20	1.59 (0.31)	10.89 (3.32)	5.95	5.93 (1.76)
$(La/Sm)_{CN}$	20	0.26 (0.05)	11.49 (3.93)	1.32	1.98 (0.57)
$(La/Y)_{CN}$	20	0.71 (0.13)	4.94 (1.22)	2.94	2.81 (0.61)
Eu_A = Eu/Eu*	20	5.01 (0.27)	489.74 (77.04)	24.15	57.69 (6.57)
Ce_A = Ce/Ce*	20	0.73 (0.04)	1.00 (0.05)	0.95	0.93 (0.06)

n.d. = not determined

TABLE B6. Rocher Déboulé, BC, Canada (C1820).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	2	≤ LOD	220 (140.0)	132	132 (110.5)
Ti	2	≤ LOD	11 (6.4)	7	7 (3.6)
V	1	≤ LOD	2 (1.3)	2	2 (1.3)
Cr	1	≤ LOD	1 (4.1)	1	1 (4.1)
Mn	16	≤ LOD	5.9 (1.1)	1.6	2.1 (0.7)
Fe	5	≤ LOD	650 (360.0)	27	224 (101.8)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	2	≤ LOD	130 (100.0)	66	66 (51.2)
Cu	3	≤ LOD	130 (100.0)	82	73 (54.4)
Zn	2	≤ LOD	28 (19.0)	15	15 (10.4)
As	19	3 (0.2)	21 (14.0)	3	5 (1.4)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	19	97.2 (1.9)	131.0 (12.0)	104.8	107.2 (2.4)
Y	19	44.4 (1.0)	176.3 (2.1)	95.5	101.4 (1.5)
Mo	19	435 (5.9)	933 (15.0)	645	687 (11.1)
Ag	0	≤ LOD	0.9 (0.8)	n.d.	n.d.
Sn	1	≤ LOD	1.6 (1.2)	1.6	1.6 (1.2)
Ba	2	≤ LOD	6 (2.7)	4	4 (1.5)
W	19	718000 (12000)	750000 (8800)	740000	737842 (11463)
La	19	30.4 (0.68)	74.9 (1.70)	47.6	49.3 (0.76)
Ce	19	97.7 (2.10)	209.0 (4.40)	138.4	140.8 (2.31)
Pr	19	15.6 (0.23)	30.9 (0.56)	21.2	21.4 (0.34)
Nd	19	84.2 (1.60)	163.1 (2.50)	114.5	116.1 (1.82)
Sm	19	17.7 (0.44)	43.0 (0.73)	29.6	30.3 (0.56)
Eu	19	2.73 (0.07)	6.54 (0.11)	4.22	4.32 (0.09)
Gd	19	17.1 (0.38)	52.0 (0.98)	33.2	34.5 (0.64)
Tb	19	2.0 (0.05)	6.9 (0.12)	4.1	4.3 (0.08)
Dy	19	11.3 (0.28)	42.0 (0.66)	23.9	25.2 (0.46)
Ho	19	2.2 (0.05)	8.2 (0.12)	4.6	4.9 (0.09)
Er	19	5.4 (0.13)	20.9 (0.36)	11.3	12.2 (0.23)
Tm	19	0.6 (0.02)	2.4 (0.05)	1.3	1.4 (0.03)
Yb	19	3.1 (0.12)	12.5 (0.32)	6.4	6.9 (0.16)
Lu	17	≤ LOD	1.8 (0.05)	1.0	1.0 (0.03)
∑REE + Y	19	369.4 (2.7)	844.6 (5.5)	542.2	554.0 (3.2)
$(La/Lu)_{CN}$	19	3.15 (0.72)	12.18 (2.73)	5.24	5.76 (1.23)
$(La/Sm)_{CN}$	19	0.72 (0.15)	1.52 (0.31)	1.05	1.04 (0.19)
$(La/Y)_{CN}$	19	1.79 (0.35)	6.77 (1.22)	3.54	3.59 (0.63)
Eu_A = Eu/Eu*	19	0.34 (0.01)	0.50 (0.02)	0.40	0.41 (0.02)
Ce_A = Ce/Ce*	19	1.01 (0.04)	1.08 (0.05)	1.03	1.04 (0.05)

n.d. = not determined

TABLE B7. Emerald, BC, Canada (C1823).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	20	43.2 (0.7)	73.6 (1.0)	57.9	59.1 (1.1)
Fe	3	≤ LOD	209 (56.0)	171	165 (33.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	19	≤ LOD	3 (0.2)	2	2 (0.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	14.3 (0.3)	22.3 (0.3)	18.4	18.3 (0.3)
Y	20	25.8 (0.3)	143.4 (2.5)	60.7	70.2 (1.2)
Mo	20	32120 (350.0)	55630 (800.0)	48960	46967 (638.0)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	20	742000 (14000)	796000 (12000)	759500	762095 (11285)
La	20	109.8 (1.20)	289.3 (3.20)	185.0	189.8 (2.59)
Ce	20	180.8 (2.30)	482.8 (6.00)	299.6	311.3 (4.43)
Pr	20	18.6 (0.31)	45.9 (0.69)	26.8	30.6 (0.47)
Nd	20	66.3 (0.97)	159.0 (2.40)	90.9	105.3 (1.62)
Sm	20	11.7 (0.27)	30.6 (0.45)	16.6	20.0 (0.41)
Eu	20	1.28 (0.04)	4.47 (0.11)	2.40	2.36 (0.06)
Gd	20	9.3 (0.27)	26.9 (0.48)	13.6	16.6 (0.36)
Tb	20	1.3 (0.03)	4.2 (0.12)	2.1	2.5 (0.06)
Dy	20	6.7 (0.15)	27.7 (0.51)	13.2	15.4 (0.31)
Ho	20	1.1 (0.03)	5.4 (0.10)	2.4	2.8 (0.06)
Er	20	2.4 (0.07)	15.2 (0.20)	6.0	7.2 (0.16)
Tm	19	≤ LOD	2.1 (0.05)	0.8	0.9 (0.03)
Yb	20	1.3 (0.06)	12.0 (0.23)	4.3	4.9 (0.14)
Lu	9	≤ LOD	1.2 (0.04)	0.7	0.7 (0.03)
∑REE + Y	20	461.8 (3.1)	1191.5 (9.6)	693.9	780.4 (5.5)
$(La/Lu)_{CN}$	20	17.91 (3.79)	93.77 (28.22)	40.64	45.71 (11.28)
$(La/Sm)_{CN}$	20	5.10 (0.89)	9.70 (1.99)	5.86	6.06 (1.12)
$(La/Y)_{CN}$	20	9.98 (1.85)	32.49 (5.63)	18.35	19.46 (3.25)
Eu_A = Eu/Eu*	20	0.27 (0.01)	0.64 (0.03)	0.37	0.39 (0.02)
Ce_A = Ce/Ce*	20	0.86 (0.04)	0.96 (0.04)	0.89	0.90 (0.04)

n.d. = not determined

TABLE B8. Kalzas, YT, Canada (CMNOC 1194).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	5	35.9 (0.7)	56.0 (0.8)	52.5	49.7 (0.8)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	0	≤ LOD	≤ LOD	n.d.	n.d.
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	5	158.7 (1.9)	224.2 (2.7)	175.8	179.5 (2.1)
Y	5	34.8 (0.5)	160.1 (1.8)	82.1	90.2 (1.0)
Mo	5	5 (0.3)	8 (0.3)	6	6 (0.3)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	5	808000 (11000)	819000 (11000)	814000	813200 (11600)
La	5	0.3 (0.02)	31.1 (0.73)	15.1	13.2 (0.30)
Ce	4	≤ LOD	50.3 (0.89)	28.8	27.3 (0.47)
Pr	3	≤ LOD	4.7 (0.09)	3.9	3.3 (0.07)
Nd	3	≤ LOD	19.0 (0.33)	9.3	10.4 (0.21)
Sm	3	≤ LOD	6.5 (0.16)	1.9	3.0 (0.11)
Eu	5	4.27 (0.10)	21.22 (0.31)	14.14	13.49 (0.22)
Gd	5	0.4 (0.05)	9.9 (0.23)	1.3	2.9 (0.10)
Tb	5	0.3 (0.02)	2.2 (0.04)	0.5	0.8 (0.02)
Dy	5	4.0 (0.10)	18.2 (0.26)	7.3	8.6 (0.18)
Ho	5	1.4 (0.04)	4.5 (0.08)	2.5	2.6 (0.05)
Er	5	6.7 (0.12)	16.7 (0.28)	11.8	11.1 (0.20)
Tm	5	1.5 (0.04)	3.2 (0.06)	2.7	2.5 (0.05)
Yb	5	12.0 (0.25)	27.4 (0.44)	23.6	20.2 (0.35)
Lu	5	1.7 (0.03)	4.3 (0.06)	3.3	3.0 (0.05)
∑REE + Y	5	67.6 (0.3)	340.2 (1.0)	193.4	200.4 (0.8)
$(La/Lu)_{CN}$	5	0.02 (0.01)	0.76 (0.15)	0.46	0.38 (0.07)
$(La/Sm)_{CN}$	5	1.46 (0.31)	18.44 (8.33)	10.39	9.48 (3.52)
$(La/Y)_{CN}$	5	0.06 (0.02)	1.55 (0.29)	0.63	0.82 (0.15)
Eu_A = Eu/Eu*	5	5.35 (0.24)	87.80 (14.75)	52.37	47.56 (6.83)
Ce_A = Ce/Ce*	5	0.21 (0.03)	1.10 (0.05)	0.77	0.66 (0.04)

n.d. = not determined

TABLE B9. Crane, ON, Canada (CMNMC 40242).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	≤ LOD	1 (0.6)	1	1 (0.6)
Mn	4	8.9 (0.5)	10.3 (0.5)	9.4	9.5 (0.5)
Fe	4	3 (0.7)	51 (17.0)	4	15 (4.8)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	1	≤ LOD	2 (0.2)	2	2 (0.2)
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	4	4 (0.4)	8 (0.6)	5	6 (0.4)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	4	563.1 (5.4)	601.4 (6.5)	586.8	584.5 (6.1)
Y	4	171.8 (2.0)	184.1 (2.6)	178.9	178.4 (2.3)
Mo	4	475 (5.1)	695 (21.0)	497	541 (9.8)
Ag	0	≤ LOD	0.6 (0.1)	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	1	≤ LOD	2 (0.2)	2	2 (0.2)
W	4	1033000 (12000)	1061000 (15000)	1048500	1047750 (13000)
La	4	2.2 (0.07)	3.1 (0.16)	2.6	2.7 (0.10)
Ce	4	13.6 (0.33)	17.2 (0.49)	14.5	14.9 (0.41)
Pr	4	3.6 (0.08)	4.4 (0.08)	4.0	4.0 (0.10)
Nd	4	27.9 (0.50)	33.6 (0.73)	32.2	31.5 (0.65)
Sm	4	15.2 (0.43)	18.4 (0.41)	17.9	17.3 (0.42)
Eu	4	5.99 (0.09)	7.25 (0.15)	6.98	6.80 (0.13)
Gd	4	25.9 (0.45)	33.3 (0.56)	32.6	31.1 (0.58)
Tb	4	5.2 (0.09)	6.5 (0.12)	6.3	6.1 (0.10)
Dy	4	39.5 (0.63)	47.2 (0.97)	45.2	44.3 (0.79)
Ho	4	7.8 (0.11)	8.9 (0.14)	8.5	8.4 (0.13)
Er	4	17.5 (0.32)	19.4 (0.36)	18.3	18.4 (0.32)
Tm	4	1.6 (0.04)	1.8 (0.05)	1.7	1.7 (0.04)
Yb	4	5.3 (0.16)	6.0 (0.17)	5.8	5.7 (0.16)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	4	344.1 (1.1)	388.5 (1.6)	376.9	371.6 (1.4)
$(La/Lu)_{CN}$	4	0.61 (0.17)	0.91 (0.26)	0.74	0.75 (0.22)
$(La/Sm)_{CN}$	4	0.08 (0.02)	0.11 (0.03)	0.10	0.10 (0.02)
$(La/Y)_{CN}$	4	0.09 (0.02)	0.11 (0.03)	0.10	0.10 (0.02)
Eu_A = Eu/Eu*	4	0.84 (0.04)	0.91 (0.04)	0.89	0.88 (0.04)
Ce_A = Ce/Ce*	4	0.85 (0.07)	0.93 (0.06)	0.88	0.89 (0.06)

n.d. = not determined

TABLE B10. Flat River, NWT, Canada (CMNMC 40248).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	6	≤ LOD	7 (8.4)	6	5 (5.6)
B	1	≤ LOD	120 (230.0)	120	120 (230.0)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	5	≤ LOD	13 (10.0)	4	6 (12.1)
V	1	≤ LOD	4 (2.9)	4	4 (2.9)
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	7	9.0 (11.0)	73.0 (59.0)	24.7	26.9 (17.0)
Fe	3	≤ LOD	50 (47.0)	26	27 (29.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	4	≤ LOD	5 (17.0)	3	3 (9.9)
Cu	3	≤ LOD	4 (1.9)	2	3 (2.8)
Zn	1	≤ LOD	3 (2.2)	3	3 (2.2)
As	7	2 (2.1)	5 (2.3)	4	4 (2.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	7	79.5 (7.5)	92.1 (6.3)	86.2	85.9 (7.2)
Y	7	516.0 (31.0)	1370.0 (370.0)	1040.0	956.6 (166.0)
Mo	7	32 (6.0)	66 (6.2)	51	48 (6.6)
Ag	0	≤ LOD	0.6 (0.5)	n.d.	n.d.
Sn	3	≤ LOD	0.9 (0.8)	0.7	0.7 (0.7)
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	7	948000 (81000)	1050000 (71000)	970000	991143 (85429)
La	7	38.7 (7.00)	89.0 (15.00)	56.0	58.7 (10.80)
Ce	7	175.0 (24.00)	423.0 (83.00)	241.0	267.3 (47.43)
Pr	7	33.3 (3.70)	74.0 (16.00)	47.0	50.8 (8.84)
Nd	7	163.0 (17.00)	364.0 (58.00)	282.0	275.7 (49.71)
Sm	7	45.2 (5.00)	156.0 (15.00)	122.0	105.4 (22.34)
Eu	7	7.16 (0.71)	15.30 (2.10)	13.30	11.92 (1.70)
Gd	7	37.2 (5.00)	183.0 (58.00)	127.0	116.9 (25.03)
Tb	7	8.6 (0.85)	38.5 (3.20)	24.8	23.9 (5.35)
Dy	7	73.8 (6.40)	278.0 (22.00)	201.0	185.3 (38.87)
Ho	7	18.0 (1.90)	57.0 (20.00)	41.3	39.1 (9.26)
Er	7	58.7 (2.30)	173.0 (41.00)	129.0	119.4 (24.61)
Tm	7	8.4 (0.88)	29.1 (7.50)	18.6	17.6 (4.05)
Yb	7	51.9 (4.50)	165.0 (30.00)	96.0	96.5 (19.54)
Lu	7	6.0 (0.70)	17.5 (2.30)	10.4	10.6 (2.24)
∑REE + Y	7	1292.2 (33.3)	3277.3 (164.7)	2500.6	2335.7 (97.6)
$(La/Lu)_{CN}$	7	0.40 (0.31)	0.75 (0.36)	0.60	0.59 (0.36)
$(La/Sm)_{CN}$	7	0.20 (0.13)	0.91 (0.40)	0.38	0.41 (0.24)
$(La/Y)_{CN}$	7	0.26 (0.17)	0.72 (0.31)	0.44	0.44 (0.25)
$Eu_A = Eu/Eu^*$	7	0.21 (0.09)	0.99 (0.20)	0.32	0.40 (0.12)
$Ce_A = Ce/Ce^*$	7	0.98 (0.29)	1.16 (0.43)	1.08	1.07 (0.34)

n.d. = not determined

TABLE B11. Tulare, California, USA (CMNMC 40254).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	5	1.4 (0.3)	2.3 (0.8)	1.7	1.7 (0.4)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	0	≤ LOD	≤ LOD	n.d.	n.d.
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	5	73.6 (1.1)	75.3 (0.8)	74.9	74.6 (1.0)
Y	5	3.0 (0.1)	4.8 (0.1)	3.3	3.8 (0.1)
Mo	5	104 (1.2)	109 (2.0)	108	107 (1.6)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	5	781000 (13000)	810000 (11000)	806000	801000 (11800)
La	0	≤ LOD	≤ LOD	n.d.	n.d.
Ce	0	≤ LOD	≤ LOD	n.d.	n.d.
Pr	0	≤ LOD	≤ LOD	n.d.	n.d.
Nd	2	≤ LOD	0.8 (0.06)	0.7	0.7 (0.06)
Sm	0	≤ LOD	≤ LOD	n.d.	n.d.
Eu	0	≤ LOD	≤ LOD	n.d.	n.d.
Gd	5	0.2 (0.03)	0.5 (0.05)	0.3	0.3 (0.04)
Tb	0	≤ LOD	≤ LOD	n.d.	n.d.
Dy	5	0.4 (0.03)	0.7 (0.04)	0.5	0.5 (0.04)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	5	0.3 (0.03)	0.5 (0.03)	0.4	0.4 (0.03)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	2	≤ LOD	0.3 (0.04)	0.3	0.3 (0.03)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	5	5.3 (0.1)	8.9 (0.1)	5.8	6.9 (0.1)
$(La/Lu)_{CN}$	5	0.22 (0.11)	0.36 (0.17)	0.28	0.29 (0.14)
$(La/Sm)_{CN}$	5	0.27 (0.16)	0.33 (0.18)	0.29	0.29 (0.15)
$(La/Y)_{CN}$	5	0.13 (0.05)	0.17 (0.05)	0.15	0.15 (0.05)
Eu_A = Eu/Eu*	5	0.25 (0.08)	0.41 (0.13)	0.30	0.31 (0.09)
Ce_A = Ce/Ce*	5	1.08 (0.14)	1.20 (0.22)	1.16	1.14 (0.20)

n.d. = not determined

TABLE B12. Traversella, Italy (CMNMC 40266).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	5	≤ LOD	10 (11.0)	6	7 (8.0)
B	10	≤ LOD	29 (1.8)	26	26 (2.4)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	90 (190.0)	90	90 (190.0)
Ti	5	≤ LOD	10 (17.0)	5	5 (11.9)
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	5	≤ LOD	12 (15.0)	3	5 (10.9)
Mn	3	≤ LOD	5.8 (5.9)	3.9	3.9 (4.7)
Fe	9	≤ LOD	22 (21.0)	4	11 (13.6)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	2	≤ LOD	7 (8.4)	4	4 (6.4)
Cu	3	≤ LOD	4 (4.3)	4	3 (2.7)
Zn	5	≤ LOD	3 (1.9)	2	2 (2.0)
As	13	8 (2.1)	191 (16.0)	30	64 (6.8)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	13	56.4 (0.6)	148.0 (41.0)	65.4	74.8 (7.2)
Y	13	32.4 (3.6)	303.0 (24.0)	135.9	166.7 (11.9)
Mo	13	594 (41.0)	1194 (86.0)	1099	1017 (71.1)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	13	804500 (9300)	970000 (68000)	889000	880654 (51792)
La	13	6.4 (0.76)	38.0 (3.10)	17.5	22.3 (1.66)
Ce	13	20.6 (2.70)	151.0 (12.00)	74.9	90.2 (6.48)
Pr	13	4.7 (0.61)	36.7 (2.70)	16.9	21.4 (1.61)
Nd	13	35.2 (4.40)	262.0 (21.00)	124.4	157.4 (11.01)
Sm	13	13.8 (1.80)	109.7 (9.70)	50.8	63.5 (5.20)
Eu	13	1.02 (0.03)	2.57 (0.34)	1.79	1.76 (0.26)
Gd	13	18.3 (2.40)	127.0 (11.00)	58.7	72.6 (5.72)
Tb	13	2.4 (0.27)	15.8 (1.00)	7.0	9.0 (0.67)
Dy	13	13.4 (1.60)	86.2 (6.50)	38.4	49.5 (3.67)
Ho	13	2.2 (0.24)	15.3 (1.20)	6.6	8.5 (0.65)
Er	13	4.7 (0.66)	31.7 (2.50)	13.3	17.0 (1.51)
Tm	13	0.3 (0.08)	2.7 (0.29)	1.1	1.4 (0.18)
Yb	13	1.4 (0.42)	9.0 (1.10)	3.9	4.7 (0.63)
Lu	4	≤ LOD	0.8 (0.13)	0.7	0.7 (0.14)
∑REE + Y	13	158.2 (6.3)	1183.9 (29.0)	546.2	686.2 (15.9)
$(La/Lu)_{CN}$	13	4.39 (2.28)	8.43 (5.02)	6.19	6.47 (3.37)
$(La/Sm)_{CN}$	13	0.19 (0.14)	0.29 (0.15)	0.22	0.23 (0.08)
$(La/Y)_{CN}$	13	0.80 (0.31)	1.31 (0.63)	0.94	0.93 (0.34)
Eu_A = Eu/Eu*	13	0.05 (0.01)	0.44 (0.10)	0.07	0.10 (0.02)
Ce_A = Ce/Ce*	13	0.85 (0.20)	0.94 (0.04)	0.87	0.89 (0.14)

n.d. = not determined

TABLE B13. Dae Hwa (Taewha), South Korea (CMNMC 40273).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	8	≤ LOD	12 (8.5)	4	5 (4.8)
B	10	25 (2.2)	30 (1.4)	28	28 (1.7)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	4	≤ LOD	7 (10.0)	4	4 (8.2)
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	2	≤ LOD	2 (7.9)	2	2 (7.6)
Mn	10	2.0 (6.4)	8.0 (5.6)	6.8	5.8 (5.3)
Fe	1	≤ LOD	4 (13.0)	4	4 (13.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	2	≤ LOD	3 (5.2)	2	2 (4.6)
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	4	≤ LOD	2 (0.9)	2	2 (0.9)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	10	2444.0 (91.0)	7300.0 (1100.0)	4850.0	4924.4 (472.1)
Y	10	196.0 (12.0)	378.0 (32.0)	291.5	292.6 (24.0)
Mo	5	≤ LOD	495 (54.0)	7	104 (12.4)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	10	848000 (46000)	928000 (36000)	904500	896400 (41600)
La	10	38.7 (4.10)	138.2 (8.50)	75.7	78.0 (9.51)
Ce	10	121.6 (8.70)	310.0 (21.00)	243.0	239.5 (27.07)
Pr	10	19.8 (1.40)	59.3 (3.70)	34.2	37.5 (4.46)
Nd	10	79.0 (23.00)	281.0 (31.00)	147.0	170.3 (21.96)
Sm	10	18.7 (6.00)	76.5 (7.60)	39.3	45.4 (6.12)
Eu	10	6.08 (0.58)	22.60 (2.30)	18.90	16.80 (1.97)
Gd	10	19.0 (5.50)	88.0 (11.00)	48.2	53.6 (6.81)
Tb	10	5.5 (1.30)	16.5 (1.30)	11.6	11.5 (1.15)
Dy	10	50.0 (11.00)	133.9 (8.90)	100.8	99.5 (8.47)
Ho	10	12.6 (2.40)	27.8 (1.40)	22.0	21.6 (1.82)
Er	10	50.2 (8.10)	81.4 (5.50)	74.8	71.4 (5.65)
Tm	10	11.7 (1.10)	16.3 (0.99)	13.4	13.3 (1.15)
Yb	10	64.1 (7.10)	123.0 (11.00)	106.9	95.5 (8.58)
Lu	10	5.9 (0.68)	15.6 (1.10)	12.8	11.5 (1.10)
∑REE + Y	10	833.9 (17.0)	1616.8 (42.2)	1239.4	1257.9 (40.7)
$(La/Lu)_{CN}$	10	0.51 (0.20)	1.11 (0.39)	0.65	0.73 (0.34)
$(La/Sm)_{CN}$	10	0.49 (0.22)	3.23 (1.32)	1.20	1.39 (0.73)
$(La/Y)_{CN}$	10	1.13 (0.49)	3.45 (1.17)	1.68	1.83 (0.81)
$Eu_A = Eu/Eu^*$	10	0.55 (0.09)	1.70 (0.28)	1.22	1.11 (0.29)
$Ce_A = Ce/Ce^*$	10	0.94 (0.12)	1.11 (0.18)	1.07	1.05 (0.23)

n.d. = not determined

TABLE B14. Guadalupana, Sonora, Mexico (CMNMC 40276).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	5	3.2 (0.3)	3.5 (0.3)	3.2	3.3 (0.3)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	5	29 (1.1)	32 (1.5)	30	30 (1.3)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	5	81.3 (1.0)	83.3 (1.1)	82.2	82.3 (1.0)
Y	5	212.6 (2.6)	228.5 (2.1)	221.4	220.2 (2.2)
Mo	5	2189 (24.0)	2260 (31.0)	2214	2215 (27.6)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	5	801000 (12000)	810000 (11000)	805000	805820 (10760)
La	5	16.9 (0.20)	19.0 (0.21)	18.1	17.9 (0.23)
Ce	5	80.8 (0.99)	92.2 (1.00)	85.7	86.2 (0.99)
Pr	5	19.3 (0.26)	21.8 (0.26)	20.2	20.4 (0.26)
Nd	5	141.0 (1.70)	159.1 (1.90)	147.5	149.1 (1.84)
Sm	5	58.9 (0.85)	64.5 (0.85)	61.0	61.5 (0.89)
Eu	5	4.25 (0.08)	4.69 (0.11)	4.44	4.49 (0.09)
Gd	5	71.4 (0.96)	76.0 (0.98)	74.0	73.9 (1.02)
Tb	5	9.3 (0.13)	9.9 (0.14)	9.5	9.6 (0.14)
Dy	5	52.5 (0.68)	55.9 (0.68)	54.2	54.2 (0.77)
Ho	5	9.8 (0.14)	10.6 (0.12)	10.1	10.1 (0.15)
Er	5	23.6 (0.35)	25.4 (0.38)	24.1	24.3 (0.36)
Tm	5	2.6 (0.05)	2.7 (0.05)	2.6	2.6 (0.05)
Yb	5	12.5 (0.23)	13.6 (0.26)	13.0	13.0 (0.25)
Lu	5	1.7 (0.04)	1.9 (0.05)	1.8	1.8 (0.04)
∑REE + Y	5	717.0 (2.5)	785.7 (2.7)	747.6	749.4 (2.7)
$(La/Lu)_{CN}$	5	1.00 (0.19)	1.05 (0.20)	1.01	1.02 (0.19)
$(La/Sm)_{CN}$	5	0.18 (0.03)	0.19 (0.03)	0.18	0.18 (0.03)
$(La/Y)_{CN}$	5	0.53 (0.08)	0.55 (0.08)	0.54	0.54 (0.08)
Eu_A = Eu/Eu*	5	0.20 (0.01)	0.21 (0.01)	0.20	0.20 (0.01)
Ce_A = Ce/Ce*	5	0.92 (0.04)	0.95 (0.05)	0.94	0.94 (0.04)

n.d. = not determined

TABLE B15. A.M. Berges W-Prospect, Mexico (CMNMC 40278).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	14	≤ LOD	15 (21.0)	7	8 (11.2)
B	44	21 (3.0)	35 (4.6)	26	27 (3.7)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	12	≤ LOD	180 (310.0)	80	91 (117.8)
Ti	24	≤ LOD	28 (43.0)	8	10 (18.6)
V	21	≤ LOD	8 (1.8)	5	5 (2.5)
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	1	≤ LOD	6.0 (11.0)	6.0	6.0 (11.0)
Fe	2	≤ LOD	97 (72.0)	50	50 (40.3)
Co	4	≤ LOD	3.8 (1.4)	1.5	1.9 (1.2)
Ni	10	≤ LOD	11 (8.4)	3	4 (7.1)
Cu	31	≤ LOD	800 (1000.0)	8	79 (74.1)
Zn	18	≤ LOD	8 (12.0)	2	3 (3.7)
As	43	≤ LOD	720 (440.0)	26	48 (23.9)
Rb	3	≤ LOD	0.9 (0.7)	0.7	0.7 (0.7)
Sr	44	266.0 (47.0)	5200.0 (1600.0)	932.0	1336.9 (329.4)
Y	6	≤ LOD	1.0 (0.5)	0.7	0.7 (0.4)
Mo	44	780 (380.0)	160000 (97000.0)	32000	39869 (9836.0)
Ag	5	≤ LOD	68.0 (32.0)	11.2	24.7 (16.3)
Sn	16	≤ LOD	1.7 (2.4)	0.6	0.8 (1.0)
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	44	570000 (150000)	1050000 (210000)	815000	814114 (149318)
La	40	≤ LOD	22.1 (5.60)	1.2	2.3 (0.80)
Ce	27	≤ LOD	20.5 (4.30)	2.2	4.4 (1.51)
Pr	26	≤ LOD	1.9 (0.58)	0.3	0.4 (0.19)
Nd	24	≤ LOD	9.7 (5.50)	1.0	2.0 (1.09)
Sm	2	≤ LOD	0.8 (0.41)	0.7	0.7 (0.42)
Eu	12	≤ LOD	0.41 (0.53)	0.16	0.18 (0.18)
Gd	7	≤ LOD	0.5 (0.67)	0.4	0.4 (0.41)
Tb	0	≤ LOD	≤ LOD	n.d.	n.d.
Dy	3	≤ LOD	0.7 (0.50)	0.5	0.5 (0.58)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	0	≤ LOD	≤ LOD	n.d.	n.d.
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	0	≤ LOD	≤ LOD	n.d.	n.d.
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	44	0.3 (3.0)	50.5 (7.9)	3.9	7.1 (3.4)
$(La/Lu)_{CN}$	0	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	12	1.70 (2.36)	24.64 (36.56)	5.11	6.77 (8.97)
$(La/Y)_{CN}$	33	n.d.	864.08 (1095.68)	32.20	97.28 (121.90)
$Eu_A = Eu/Eu^*$	15	n.d.	9.72 (n.d.)	2.34	2.67 (3.00)
$Ce_A = Ce/Ce^*$	44	0.43 (0.31)	2.14 (1.77)	0.82	0.87 (0.74)

n.d. = not determined

TABLE B16. Britannia Mine, BC, Canada (CMNMC 50171).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	8	≤ LOD	24 (49.0)	6	8 (13.0)
B	23	≤ LOD	54 (6.4)	45	44 (7.8)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	26 (21.0)	26	26 (21.0)
Ti	14	≤ LOD	19 (19.0)	6	8 (13.6)
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	≤ LOD	9 (41.0)	9	9 (41.0)
Mn	8	≤ LOD	15.0 (11.0)	6.0	7.0 (10.3)
Fe	6	≤ LOD	140 (220.0)	40	49 (77.5)
Co	3	≤ LOD	1.5 (1.0)	1.1	1.1 (1.0)
Ni	7	≤ LOD	10 (10.0)	6	6 (11.9)
Cu	6	≤ LOD	6 (7.6)	3	3 (3.5)
Zn	5	≤ LOD	6 (20.0)	3	3 (5.6)
As	21	≤ LOD	367 (74.0)	58	94 (15.5)
Rb	1	≤ LOD	1.0 (4.6)	1.0	1.0 (4.6)
Sr	24	69.8 (6.6)	229.0 (17.0)	85.6	93.9 (11.0)
Y	12	≤ LOD	7.5 (5.1)	2.0	2.3 (0.9)
Mo	24	3150 (260.0)	25900 (3100.0)	5760	8215 (1005.4)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	1	≤ LOD	2 (2.5)	2	2 (2.5)
W	24	790000 (130000)	1070000 (230000)	894500	909208 (97917)
La	23	≤ LOD	118.0 (22.00)	33.6	36.0 (4.05)
Ce	24	1.3 (1.30)	319.0 (71.00)	69.7	95.6 (13.11)
Pr	24	0.2 (0.15)	37.7 (5.50)	9.5	11.9 (1.77)
Nd	24	1.5 (0.83)	109.0 (21.00)	29.1	36.1 (5.73)
Sm	21	≤ LOD	10.4 (7.00)	1.5	2.3 (0.95)
Eu	21	≤ LOD	1.10 (1.10)	0.19	0.28 (0.16)
Gd	21	≤ LOD	7.8 (3.00)	0.9	1.2 (0.52)
Tb	3	≤ LOD	0.6 (0.48)	0.2	0.3 (0.22)
Dy	8	≤ LOD	2.8 (2.90)	0.7	0.9 (0.61)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	0	≤ LOD	≤ LOD	n.d.	n.d.
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	1	≤ LOD	0.6 (1.20)	0.6	0.6 (1.20)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	24	4.0 (2.7)	593.0 (77.5)	138.6	183.3 (15.5)
$(La/Lu)_{CN}$	0	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	23	0.16 (0.17)	27.43 (16.72)	10.14	10.39 (7.04)
$(La/Y)_{CN}$	23	n.d.	1454.62 (991.62)	141.86	315.46 (239.18)
Eu_A = Eu/Eu*	23	n.d.	2.37 (n.d.)	0.47	0.67 (0.50)
Ce_A = Ce/Ce*	24	0.93 (0.39)	1.38 (2.15)	1.14	1.13 (0.40)

n.d. = not determined

TABLE B17. Ortiz Mine, New Mexico, USA (CMNMC 52204).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	9	≤ LOD	18 (15.0)	9	9 (11.5)
B	21	23 (6.3)	42 (4.9)	31	33 (3.9)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	12	≤ LOD	25 (31.0)	6	9 (18.2)
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	2	≤ LOD	5 (12.0)	4	4 (12.0)
Mn	8	≤ LOD	4.9 (5.9)	3.3	3.0 (7.6)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	2	≤ LOD	4 (9.2)	3	3 (7.9)
Cu	2	≤ LOD	3 (2.9)	2	2 (2.8)
Zn	1	≤ LOD	3 (1.9)	3	3 (1.9)
As	21	24 (2.6)	109 (12.0)	38	45 (6.9)
Rb	2	≤ LOD	1.2 (0.9)	1.0	1.0 (0.9)
Sr	21	168.0 (12.0)	222.0 (23.0)	201.0	199.0 (15.0)
Y	21	188.0 (13.0)	517.0 (56.0)	309.0	334.4 (28.8)
Mo	21	3210 (260.0)	4540 (320.0)	4180	3999 (285.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	21	840000 (140000)	957000 (63000)	891000	896238 (73000)
La	21	4.5 (0.70)	19.9 (2.60)	15.0	13.9 (1.48)
Ce	21	18.4 (2.00)	67.6 (7.20)	52.1	50.2 (4.36)
Pr	21	5.0 (0.49)	16.3 (1.50)	13.2	12.7 (1.17)
Nd	21	37.4 (3.40)	141.5 (9.00)	105.0	105.1 (9.33)
Sm	21	23.4 (2.60)	80.0 (6.30)	56.0	56.3 (5.48)
Eu	21	11.67 (0.89)	46.60 (4.50)	30.80	32.48 (2.70)
Gd	21	40.3 (4.00)	130.0 (12.00)	86.7	90.2 (8.42)
Tb	21	6.6 (0.76)	19.6 (1.80)	11.7	12.1 (1.22)
Dy	21	44.1 (4.20)	113.0 (12.00)	68.4	74.2 (6.96)
Ho	21	8.2 (0.77)	21.4 (2.20)	13.8	14.8 (1.40)
Er	21	21.6 (2.60)	57.4 (6.10)	36.4	37.2 (3.67)
Tm	21	2.1 (0.31)	5.7 (0.65)	3.6	3.9 (0.45)
Yb	21	11.3 (1.50)	32.1 (3.80)	19.3	20.5 (2.29)
Lu	21	1.9 (0.34)	4.1 (0.43)	3.1	3.1 (0.39)
∑REE + Y	21	425.2 (8.2)	1182.9 (22.1)	854.7	861.0 (17.3)
$(La/Lu)_{CN}$	21	0.22 (0.13)	0.68 (0.28)	0.52	0.48 (0.23)
$(La/Sm)_{CN}$	21	0.08 (0.05)	0.26 (0.12)	0.16	0.16 (0.07)
$(La/Y)_{CN}$	21	0.11 (0.07)	0.53 (0.21)	0.31	0.29 (0.12)
Eu_A = Eu/Eu*	21	0.93 (0.18)	2.38 (0.37)	1.34	1.39 (0.23)
Ce_A = Ce/Ce*	21	0.71 (0.14)	0.90 (0.13)	0.83	0.82 (0.15)

n.d. = not determined

TABLE B18. Kumbel, Kyrgyzstan (CMNMC 53448).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	10	≤ LOD	9 (6.7)	6	6 (6.3)
B	9	≤ LOD	143 (64.0)	96	100 (39.3)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	26 (27.0)	26	26 (27.0)
Ti	11	≤ LOD	12 (8.1)	4	6 (9.5)
V	1	≤ LOD	2 (1.3)	2	2 (1.3)
Cr	2	≤ LOD	3 (16.0)	2	2 (12.3)
Mn	2	≤ LOD	5.8 (8.2)	4.6	4.6 (7.9)
Fe	2	≤ LOD	39 (81.0)	29	29 (70.0)
Co	3	≤ LOD	1.4 (0.6)	1.2	1.2 (0.5)
Ni	5	≤ LOD	8 (9.6)	4	5 (7.5)
Cu	5	≤ LOD	4 (3.1)	2	3 (3.2)
Zn	10	≤ LOD	3 (3.2)	2	2 (2.5)
As	27	≤ LOD	510 (31.0)	164	193 (22.5)
Rb	1	≤ LOD	0.7 (0.4)	0.7	0.7 (0.4)
Sr	28	72.9 (6.5)	225.0 (21.0)	88.3	96.2 (10.3)
Y	15	≤ LOD	5.0 (0.9)	1.2	1.8 (0.5)
Mo	28	3050 (230.0)	14300 (2000.0)	10850	9406 (1073.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	28	827000 (52000)	976000 (87000)	897000	892929 (76571)
La	27	≤ LOD	205.0 (11.00)	63.0	72.8 (7.78)
Ce	27	≤ LOD	487.0 (31.00)	174.0	193.9 (20.62)
Pr	28	0.3 (0.14)	49.3 (3.80)	19.3	21.4 (2.37)
Nd	28	1.9 (0.33)	103.1 (7.60)	55.0	55.8 (5.49)
Sm	28	0.5 (0.27)	10.7 (1.60)	1.9	2.7 (0.74)
Eu	27	≤ LOD	0.69 (0.17)	0.25	0.27 (0.11)
Gd	27	≤ LOD	7.3 (1.30)	0.8	1.4 (0.50)
Tb	4	≤ LOD	0.5 (0.11)	0.3	0.3 (0.10)
Dy	6	≤ LOD	2.1 (0.76)	1.0	1.1 (0.44)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	1	≤ LOD	0.5 (0.20)	0.5	0.5 (0.20)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	0	≤ LOD	≤ LOD	n.d.	n.d.
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	28	5.0 (1.9)	849.2 (34.0)	311.0	340.3 (22.5)
$(La/Lu)_{CN}$	1	697.15 (1042.04)	697.15 (1042.04)	697.15	697.15 (1042.04)
$(La/Sm)_{CN}$	28	0.17 (0.18)	65.22 (40.40)	19.51	20.05 (12.81)
$(La/Y)_{CN}$	28	3.62 (3.83)	3565.09 (3185.19)	711.55	860.89 (655.52)
Eu_A = Eu/Eu*	28	0.22 (0.16)	0.77 (0.85)	0.42	0.44 (0.34)
Ce_A = Ce/Ce*	28	0.89 (0.73)	1.27 (0.15)	1.15	1.15 (0.26)

n.d. = not determined

TABLE B19. Morro Velho, Brazil (CMNMC 55153).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	3	≤ LOD	1 (0.4)	1	1 (0.5)
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	≤ LOD	1 (0.6)	1	1 (0.6)
Mn	5	2.2 (0.4)	3.0 (0.3)	2.3	2.5 (0.4)
Fe	3	≤ LOD	4 (0.9)	3	3 (0.8)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	5	4 (0.3)	5 (0.5)	4	4 (0.3)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	5	509.7 (5.8)	569.1 (8.1)	566.7	551.5 (6.4)
Y	5	416.4 (4.2)	444.6 (5.3)	424.4	427.2 (5.1)
Mo	3	≤ LOD	1 (0.1)	1	1 (0.1)
Ag	0	≤ LOD	0.5 (0.1)	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	5	982000 (10000)	1035000 (17000)	1008000	1010400 (14200)
La	5	20.0 (0.89)	28.0 (1.40)	25.2	24.8 (1.86)
Ce	5	125.7 (3.00)	162.7 (4.70)	147.6	146.4 (6.10)
Pr	5	33.9 (0.62)	41.8 (0.91)	38.2	38.2 (1.10)
Nd	5	268.7 (4.10)	315.1 (4.60)	298.6	294.6 (5.72)
Sm	5	190.1 (2.30)	219.3 (2.90)	208.3	206.8 (3.08)
Eu	5	104.70 (1.40)	114.00 (1.20)	111.10	109.94 (1.52)
Gd	5	312.8 (4.20)	354.3 (4.50)	338.5	334.5 (4.32)
Tb	5	48.0 (0.68)	53.7 (0.69)	51.7	50.9 (0.66)
Dy	5	239.2 (3.00)	265.7 (4.00)	254.7	251.7 (3.48)
Ho	5	30.7 (0.35)	33.3 (0.52)	32.0	31.8 (0.43)
Er	5	48.9 (0.62)	52.6 (0.80)	49.9	50.3 (0.71)
Tm	5	3.5 (0.08)	3.8 (0.07)	3.5	3.6 (0.07)
Yb	5	10.5 (0.24)	11.3 (0.33)	10.6	10.8 (0.26)
Lu	5	0.7 (0.02)	0.8 (0.03)	0.7	0.7 (0.03)
∑REE + Y	5	1854.1 (7.9)	2064.7 (13.9)	2001.0	1982.3 (11.0)
$(La/Lu)_{CN}$	5	2.82 (0.78)	3.97 (1.16)	3.50	3.48 (1.14)
$(La/Sm)_{CN}$	5	0.07 (0.02)	0.08 (0.02)	0.08	0.08 (0.02)
$(La/Y)_{CN}$	5	0.32 (0.07)	0.44 (0.11)	0.39	0.39 (0.11)
Eu_A = Eu/Eu*	5	1.23 (0.04)	1.30 (0.04)	1.26	1.26 (0.04)
Ce_A = Ce/Ce*	5	0.89 (0.05)	0.92 (0.06)	0.91	0.91 (0.07)

n.d. = not determined

TABLE B20. Jardine, Montana, USA (CMNMC 80388).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	4	9.6 (0.6)	12.2 (0.5)	11.9	11.4 (0.6)
Fe	2	≤ LOD	3 (1.0)	2	2 (0.9)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	2	≤ LOD	2 (0.2)	2	2 (0.2)
Zn	1	≤ LOD	2 (0.3)	2	2 (0.3)
As	4	2 (0.2)	2 (0.2)	2	2 (0.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	4	2834.0 (31.0)	2890.0 (33.0)	2860.5	2861.3 (31.5)
Y	4	93.4 (2.4)	150.6 (2.7)	142.9	132.4 (2.6)
Mo	2	≤ LOD	1 (0.2)	1	1 (0.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	4	1056000 (13000)	1070000 (15000)	1060500	1061750 (14000)
La	4	25.7 (0.64)	32.5 (0.53)	29.0	29.0 (0.55)
Ce	4	72.9 (2.00)	103.4 (1.70)	90.6	89.4 (1.48)
Pr	4	9.5 (0.34)	15.2 (0.34)	13.1	12.7 (0.27)
Nd	4	36.7 (1.30)	66.0 (1.90)	55.5	53.4 (1.31)
Sm	4	9.8 (0.39)	20.6 (0.52)	16.7	15.9 (0.44)
Eu	4	100.00 (1.00)	114.60 (1.20)	104.25	105.78 (1.18)
Gd	4	12.7 (0.43)	27.9 (0.57)	22.1	21.2 (0.52)
Tb	4	2.5 (0.07)	5.1 (0.11)	4.2	4.0 (0.10)
Dy	4	16.7 (0.51)	33.3 (0.70)	27.9	26.4 (0.61)
Ho	4	3.1 (0.08)	5.9 (0.14)	5.2	4.9 (0.12)
Er	4	8.6 (0.22)	14.6 (0.31)	13.7	12.6 (0.28)
Tm	4	1.2 (0.04)	1.9 (0.05)	1.8	1.7 (0.05)
Yb	4	6.8 (0.19)	10.3 (0.28)	9.3	8.9 (0.26)
Lu	4	0.7 (0.03)	1.1 (0.03)	0.9	0.9 (0.03)
∑REE + Y	4	401.2 (2.9)	601.9 (3.1)	537.0	519.3 (2.6)
$(La/Lu)_{CN}$	4	2.48 (0.50)	3.92 (1.00)	3.68	3.44 (0.80)
$(La/Sm)_{CN}$	4	0.99 (0.19)	1.64 (0.42)	1.09	1.20 (0.27)
$(La/Y)_{CN}$	4	1.18 (0.19)	1.83 (0.41)	1.48	1.49 (0.30)
$Eu_A = Eu/Eu^*$	4	14.51 (0.61)	27.53 (1.64)	16.43	18.72 (0.93)
$Ce_A = Ce/Ce^*$	4	1.11 (0.05)	1.12 (0.07)	1.11	1.11 (0.06)

n.d. = not determined

TABLE B21. Yongwol, South Korea (CMNMC 80801).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	6	≤ LOD	6 (4.7)	4	4 (3.6)
B	13	19 (15.0)	71 (30.0)	48	49 (14.9)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	29 (15.0)	29	29 (15.0)
Ti	4	≤ LOD	19 (9.2)	3	7 (9.6)
V	2	≤ LOD	2 (1.0)	2	2 (1.3)
Cr	1	≤ LOD	5 (10.0)	5	5 (10.0)
Mn	13	32.0 (19.0)	101.0 (18.0)	78.0	72.7 (13.0)
Fe	1	≤ LOD	4 (27.0)	4	4 (27.0)
Co	1	≤ LOD	0.9 (0.8)	0.9	0.9 (0.8)
Ni	3	≤ LOD	7 (10.0)	3	4 (7.9)
Cu	5	≤ LOD	5 (2.0)	3	3 (2.7)
Zn	5	≤ LOD	3 (2.1)	2	2 (1.8)
As	1	≤ LOD	7 (7.1)	7	7 (7.1)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	13	88.9 (8.4)	300.0 (220.0)	103.4	117.4 (23.9)
Y	13	45.3 (4.9)	137.0 (30.0)	92.1	93.5 (11.6)
Mo	13	89 (10.0)	830 (230.0)	200	298 (97.6)
Ag	0	≤ LOD	0.5 (0.5)	n.d.	n.d.
Sn	4	≤ LOD	0.6 (0.6)	0.6	0.6 (0.7)
Ba	1	≤ LOD	3 (4.3)	3	3 (4.3)
W	13	955000 (76000)	1090000 (120000)	1018000	1013538 (75846)
La	13	29.9 (3.90)	207.0 (85.00)	56.5	72.7 (17.55)
Ce	13	42.4 (5.10)	140.0 (57.00)	63.8	78.2 (15.78)
Pr	13	2.6 (0.65)	12.0 (12.00)	5.0	6.0 (1.98)
Nd	13	4.9 (1.40)	38.0 (34.00)	13.7	17.2 (6.06)
Sm	13	0.6 (0.38)	6.5 (1.90)	3.0	3.2 (1.29)
Eu	13	2.63 (0.40)	12.90 (1.20)	6.92	7.24 (0.87)
Gd	13	1.6 (0.67)	9.1 (3.40)	3.2	3.7 (1.18)
Tb	13	0.4 (0.11)	2.1 (0.72)	1.0	1.0 (0.27)
Dy	13	5.4 (1.20)	18.9 (5.10)	11.0	11.3 (2.22)
Ho	13	1.4 (0.22)	5.9 (1.60)	3.1	3.3 (0.54)
Er	13	6.6 (1.00)	25.0 (5.40)	14.3	13.9 (1.89)
Tm	13	1.9 (0.28)	5.1 (1.20)	3.6	3.4 (0.43)
Yb	13	20.1 (1.50)	56.5 (3.30)	36.6	34.6 (3.50)
Lu	13	2.9 (0.39)	9.4 (0.57)	5.6	5.4 (0.60)
∑REE + Y	13	178.0 (8.4)	641.7 (103.3)	322.9	354.6 (26.5)
$(La/Lu)_{CN}$	13	0.69 (0.28)	2.86 (2.26)	1.33	1.41 (0.77)
$(La/Sm)_{CN}$	13	3.82 (2.75)	38.16 (34.60)	14.57	17.51 (13.71)
$(La/Y)_{CN}$	13	2.48 (1.45)	10.04 (7.97)	4.47	4.97 (2.74)
$Eu_A = Eu/Eu^*$	13	2.21 (0.89)	15.98 (7.30)	7.41	7.89 (4.31)
$Ce_A = Ce/Ce^*$	13	0.47 (0.56)	1.10 (0.35)	0.68	0.74 (0.24)

n.d. = not determined

TABLE B22. Sanford, Maine, USA (CMNMC 85546).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	5	8.8 (0.4)	10.0 (0.4)	9.5	9.4 (0.4)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	0	≤ LOD	≤ LOD	n.d.	n.d.
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	5	126.7 (1.5)	186.3 (2.6)	173.3	162.6 (2.0)
Y	5	1.2 (0.1)	3.6 (0.1)	2.0	2.2 (0.1)
Mo	5	428 (4.7)	692 (12.0)	600	573 (8.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	5	809000 (12000)	819000 (11000)	812000	813360 (10900)
La	5	6.4 (0.12)	8.8 (0.12)	7.7	7.6 (0.12)
Ce	5	10.5 (0.14)	14.9 (0.18)	11.0	12.2 (0.17)
Pr	5	1.0 (0.03)	1.6 (0.05)	1.2	1.3 (0.04)
Nd	5	3.1 (0.12)	6.4 (0.18)	4.4	4.8 (0.15)
Sm	5	0.5 (0.05)	1.2 (0.08)	0.7	0.8 (0.06)
Eu	5	0.12 (0.01)	0.35 (0.02)	0.18	0.21 (0.02)
Gd	5	0.5 (0.04)	0.9 (0.06)	0.6	0.6 (0.05)
Tb	0	≤ LOD	≤ LOD	n.d.	n.d.
Dy	3	≤ LOD	0.8 (0.04)	0.7	0.7 (0.04)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	1	≤ LOD	0.4 (0.03)	0.4	0.4 (0.03)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	0	≤ LOD	≤ LOD	n.d.	n.d.
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	5	25.5 (0.2)	39.4 (0.3)	27.2	30.8 (0.3)
$(La/Lu)_{CN}$	5	34.87 (14.09)	192.98 (135.46)	41.54	83.67 (48.99)
$(La/Sm)_{CN}$	5	4.71 (1.35)	9.64 (3.07)	5.82	6.32 (1.95)
$(La/Y)_{CN}$	5	16.16 (3.27)	37.14 (10.14)	20.99	25.71 (5.84)
Eu_A = Eu/Eu*	5	0.50 (0.07)	1.77 (0.26)	0.54	0.98 (0.14)
Ce_A = Ce/Ce*	5	0.80 (0.04)	0.89 (0.04)	0.89	0.87 (0.04)

n.d. = not determined

TABLE B23. Carrock Fell, United Kingdom (CMNMC 85817).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	8	105.4 (1.6)	118.4 (1.3)	110.7	111.2 (1.6)
Fe	1	≤ LOD	2 (1.0)	2	2 (1.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	1	≤ LOD	2 (0.2)	2	2 (0.2)
Zn	1	≤ LOD	2 (0.2)	2	2 (0.2)
As	2	≤ LOD	5 (0.5)	3	3 (0.4)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	8	113.4 (1.2)	149.4 (1.9)	117.4	123.1 (1.6)
Y	8	10.8 (0.2)	30.9 (0.4)	16.9	18.9 (0.3)
Mo	8	2 (0.2)	8 (0.7)	3	4 (0.3)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	8	1049000 (15000)	1094000 (14000)	1078500	1074250 (14750)
La	8	0.8 (0.04)	5.9 (0.21)	2.6	2.9 (0.09)
Ce	6	≤ LOD	5.6 (0.14)	2.3	2.7 (0.08)
Pr	4	≤ LOD	0.4 (0.02)	0.3	0.3 (0.02)
Nd	3	≤ LOD	1.9 (0.24)	1.6	1.7 (0.18)
Sm	3	≤ LOD	1.6 (0.24)	1.4	1.2 (0.18)
Eu	8	0.82 (0.04)	11.13 (0.23)	2.76	3.58 (0.13)
Gd	7	≤ LOD	2.6 (0.31)	0.6	1.0 (0.13)
Tb	5	≤ LOD	0.6 (0.04)	0.3	0.3 (0.02)
Dy	8	1.1 (0.07)	5.1 (0.23)	1.9	2.4 (0.11)
Ho	8	0.3 (0.02)	1.3 (0.04)	0.5	0.6 (0.03)
Er	8	1.6 (0.06)	4.8 (0.16)	2.3	2.7 (0.10)
Tm	8	0.4 (0.02)	1.0 (0.03)	0.6	0.7 (0.03)
Yb	8	4.5 (0.15)	9.7 (0.25)	6.1	6.7 (0.21)
Lu	8	0.8 (0.03)	1.4 (0.04)	1.1	1.1 (0.04)
∑REE + Y	8	22.0 (0.2)	78.6 (0.8)	43.9	44.5 (0.4)
$(La/Lu)_{CN}$	8	0.09 (0.03)	0.46 (0.11)	0.23	0.26 (0.07)
$(La/Sm)_{CN}$	8	0.70 (0.32)	16.35 (10.90)	6.14	7.76 (3.99)
$(La/Y)_{CN}$	8	0.38 (0.10)	2.18 (0.43)	0.88	1.02 (0.22)
Eu_A = Eu/Eu*	8	5.63 (1.26)	68.41 (12.88)	19.57	23.95 (5.48)
Ce_A = Ce/Ce*	8	0.25 (0.02)	0.74 (0.06)	0.45	0.47 (0.04)

n.d. = not determined

TABLE B24. Sigma, QC, Canada (CMNMC 86063).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	4	6.7 (0.4)	8.8 (0.4)	7.1	7.4 (0.4)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	4	6 (0.3)	11 (0.7)	9	9 (0.5)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	4	260.0 (3.1)	289.9 (3.0)	283.0	279.0 (3.0)
Y	4	360.3 (3.1)	409.7 (4.5)	402.0	393.5 (3.8)
Mo	4	15 (0.5)	17 (0.5)	15	16 (0.5)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	4	914000 (13000)	956000 (11000)	948500	941750 (12750)
La	4	4.9 (0.10)	9.3 (0.15)	7.7	7.4 (0.13)
Ce	4	36.3 (0.45)	58.8 (0.68)	52.7	50.1 (0.60)
Pr	4	10.7 (0.13)	16.0 (0.23)	14.4	13.9 (0.19)
Nd	4	82.8 (1.20)	125.8 (1.60)	112.0	108.1 (1.38)
Sm	4	44.6 (0.77)	69.4 (1.20)	62.2	59.6 (0.95)
Eu	4	54.18 (0.65)	64.51 (0.74)	55.60	57.47 (0.69)
Gd	4	67.3 (0.91)	112.2 (1.80)	102.1	95.9 (1.30)
Tb	4	12.3 (0.15)	18.5 (0.30)	17.6	16.5 (0.22)
Dy	4	82.8 (0.89)	116.3 (1.30)	111.5	105.5 (1.32)
Ho	4	14.6 (0.15)	19.8 (0.27)	19.2	18.2 (0.23)
Er	4	35.1 (0.49)	43.6 (0.61)	43.0	41.2 (0.53)
Tm	4	4.0 (0.08)	4.5 (0.08)	4.3	4.3 (0.08)
Yb	4	16.6 (0.35)	18.1 (0.36)	17.0	17.2 (0.33)
Lu	4	1.4 (0.04)	1.5 (0.04)	1.4	1.4 (0.04)
∑REE + Y	4	838.0 (2.2)	1077.0 (3.3)	1022.9	990.2 (2.8)
$(La/Lu)_{CN}$	4	0.37 (0.08)	0.69 (0.14)	0.56	0.54 (0.11)
$(La/Sm)_{CN}$	4	0.07 (0.01)	0.08 (0.02)	0.08	0.08 (0.01)
$(La/Y)_{CN}$	4	0.09 (0.02)	0.15 (0.02)	0.13	0.12 (0.02)
Eu_A = Eu/Eu*	4	1.89 (0.07)	3.57 (0.13)	2.10	2.41 (0.08)
Ce_A = Ce/Ce*	4	0.86 (0.04)	0.92 (0.05)	0.88	0.89 (0.05)

n.d. = not determined

TABLE B25. Cantung, NWT, Canada (CXXXX).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	17	≤ LOD	3 (0.3)	2	2 (0.2)
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	2	≤ LOD	42 (43.0)	22	22 (21.9)
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	34	6.8 (0.3)	88.0 (21.0)	16.6	19.9 (1.2)
Fe	9	≤ LOD	540 (180.0)	54	162 (42.9)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	6	≤ LOD	2 (0.2)	2	2 (0.1)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	34	46.2 (0.8)	62.6 (1.0)	53.9	53.9 (0.9)
Y	34	9.5 (0.2)	306.9 (8.3)	76.4	87.3 (2.7)
Mo	34	66 (1.2)	311 (4.6)	110	138 (3.0)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	34	548000 (10000)	786000 (10000)	726500	670353 (9624)
La	34	2.7 (0.07)	329.0 (14.00)	69.5	84.4 (6.15)
Ce	34	8.0 (0.15)	663.0 (27.00)	143.7	179.0 (9.64)
Pr	34	1.4 (0.04)	57.8 (1.80)	13.1	18.4 (0.77)
Nd	34	9.4 (0.21)	180.1 (4.80)	40.4	60.0 (2.04)
Sm	34	2.6 (0.13)	35.1 (0.83)	6.2	10.4 (0.34)
Eu	34	1.22 (0.04)	35.39 (0.44)	17.96	17.98 (0.40)
Gd	34	1.7 (0.10)	26.7 (0.70)	5.3	8.2 (0.26)
Tb	34	0.3 (0.02)	4.0 (0.11)	0.9	1.3 (0.04)
Dy	34	2.2 (0.13)	30.7 (0.67)	7.7	9.7 (0.29)
Ho	34	0.4 (0.03)	6.9 (0.15)	1.7	2.1 (0.06)
Er	34	0.7 (0.04)	28.1 (0.77)	6.8	8.0 (0.25)
Tm	29	≤ LOD	6.8 (0.18)	1.6	2.1 (0.07)
Yb	32	≤ LOD	69.0 (1.90)	13.6	17.5 (0.64)
Lu	25	≤ LOD	10.0 (0.28)	2.5	3.2 (0.12)
∑REE + Y	34	58.6 (0.4)	1672.4 (30.8)	411.5	507.5 (11.8)
$(La/Lu)_{CN}$	34	1.79 (0.65)	133.54 (64.02)	3.72	12.81 (5.43)
$(La/Sm)_{CN}$	34	0.38 (0.09)	24.23 (6.10)	3.52	6.84 (2.19)
$(La/Y)_{CN}$	34	1.00 (0.21)	17.79 (4.25)	6.25	6.94 (2.11)
$Eu_A = Eu/Eu^*$	34	0.81 (0.05)	27.32 (1.63)	4.74	8.44 (0.60)
$Ce_A = Ce/Ce^*$	34	0.93 (0.09)	1.23 (0.14)	1.04	1.06 (0.12)

n.d. = not determined

TABLE B26. Castañeda de Llamuco, Chile (M1020).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	1	≤ LOD	3 (1.8)	3	3 (1.8)
B	1	≤ LOD	22 (11.0)	22	22 (11.0)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	1	≤ LOD	340 (210.0)	340	340 (210.0)
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	20	1.6 (0.2)	161.0 (88.0)	2.3	11.8 (4.7)
Fe	2	≤ LOD	330 (190.0)	175	175 (114.0)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	1	≤ LOD	22 (16.0)	22	22 (16.0)
As	20	77 (2.3)	511 (13.0)	159	195 (6.4)
Rb	1	≤ LOD	4.9 (3.0)	4.9	4.9 (3.0)
Sr	20	35.2 (0.7)	55.6 (1.2)	39.5	42.4 (0.7)
Y	20	64.1 (1.1)	918.0 (16.0)	177.7	322.5 (5.8)
Mo	20	468 (6.5)	801 (12.0)	701	674 (11.4)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	20	705000 (14000)	731000 (13000)	718500	717340 (11365)
La	20	17.5 (0.32)	55.9 (0.77)	28.6	29.0 (0.46)
Ce	20	87.4 (1.40)	261.8 (3.40)	149.5	147.7 (2.34)
Pr	20	18.2 (0.31)	51.0 (0.52)	31.8	32.6 (0.52)
Nd	20	112.0 (1.80)	336.1 (5.60)	200.4	219.4 (3.42)
Sm	20	29.6 (0.65)	182.5 (3.60)	57.0	81.7 (1.44)
Eu	20	1.58 (0.05)	8.98 (0.20)	4.42	4.80 (0.11)
Gd	20	28.4 (0.61)	253.6 (5.20)	62.2	100.2 (1.80)
Tb	20	3.2 (0.07)	37.4 (0.73)	7.7	13.5 (0.26)
Dy	20	17.1 (0.39)	232.3 (4.10)	44.2	80.9 (1.55)
Ho	20	3.1 (0.07)	43.8 (0.87)	8.4	15.3 (0.29)
Er	20	7.5 (0.13)	111.5 (2.00)	20.6	38.2 (0.75)
Tm	20	0.8 (0.02)	12.6 (0.21)	2.1	4.2 (0.09)
Yb	20	4.0 (0.11)	65.9 (1.10)	10.7	21.7 (0.43)
Lu	20	0.5 (0.02)	8.9 (0.16)	1.5	3.0 (0.07)
∑REE + Y	20	395.0 (2.5)	2444.7 (10.2)	810.5	1114.9 (5.3)
$(La/Lu)_{CN}$	20	0.33 (0.06)	3.40 (0.82)	2.21	1.93 (0.40)
$(La/Sm)_{CN}$	20	0.10 (0.02)	0.44 (0.07)	0.33	0.28 (0.05)
$(La/Y)_{CN}$	20	0.21 (0.04)	1.81 (0.34)	1.21	1.05 (0.18)
Eu_A = Eu/Eu*	20	0.13 (0.01)	0.24 (0.01)	0.18	0.18 (0.01)
Ce_A = Ce/Ce*	20	0.91 (0.05)	1.07 (0.05)	1.03	1.00 (0.05)

n.d. = not determined

TABLE B27. Tungstar, California, USA (M6258).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	18	1.4 (0.2)	22.4 (0.9)	4.3	7.0 (0.7)
Fe	5	≤ LOD	218 (56.0)	36	89 (18.7)
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	4	≤ LOD	19 (0.8)	10	11 (1.8)
As	17	≤ LOD	10 (0.5)	4	5 (0.3)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	18	64.6 (1.1)	169.2 (3.1)	140.8	132.2 (2.5)
Y	14	≤ LOD	6.5 (0.1)	1.6	2.6 (0.1)
Mo	18	2807 (46.0)	9410 (170.0)	6455	6081 (108.0)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	18	671000 (12000)	728000 (12000)	699500	699617 (11833)
La	17	≤ LOD	5.4 (0.19)	1.9	2.2 (0.06)
Ce	7	≤ LOD	9.8 (0.20)	5.9	5.8 (0.13)
Pr	12	≤ LOD	1.9 (0.05)	0.6	0.8 (0.03)
Nd	14	≤ LOD	9.7 (0.24)	2.3	3.5 (0.12)
Sm	4	≤ LOD	1.0 (0.07)	0.7	0.7 (0.06)
Eu	9	≤ LOD	0.39 (0.02)	0.16	0.21 (0.02)
Gd	9	≤ LOD	0.8 (0.05)	0.6	0.5 (0.04)
Tb	0	≤ LOD	≤ LOD	n.d.	n.d.
Dy	4	≤ LOD	0.9 (0.05)	0.7	0.7 (0.04)
Ho	0	≤ LOD	≤ LOD	n.d.	n.d.
Er	3	≤ LOD	0.6 (0.03)	0.4	0.4 (0.03)
Tm	0	≤ LOD	≤ LOD	n.d.	n.d.
Yb	1	≤ LOD	0.4 (0.03)	0.4	0.4 (0.03)
Lu	0	≤ LOD	≤ LOD	n.d.	n.d.
∑REE + Y	18	1.2 (1.7)	25.4 (1.8)	10.9	11.4 (0.5)
$(La/Lu)_{CN}$	12	0.40 (0.20)	310.04 (291.76)	30.23	76.87 (60.23)
$(La/Sm)_{CN}$	18	0.19 (0.08)	20.45 (13.09)	4.26	6.60 (3.24)
$(La/Y)_{CN}$	18	0.10 (0.04)	140.80 (49.20)	10.35	28.60 (9.21)
Eu_A = Eu/Eu*	18	0.36 (0.06)	2.40 (0.46)	0.95	1.10 (0.29)
Ce_A = Ce/Ce*	18	0.20 (0.02)	0.97 (0.05)	0.26	0.39 (0.03)

n.d. = not determined

TABLE B28. Zinnwald – Cínovec, Germany (M6348).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	16	≤ LOD	6.1 (0.3)	2.5	2.8 (0.3)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	16	≤ LOD	5 (0.3)	2	3 (0.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	1938.0 (41.0)	2385.0 (40.0)	2178.0	2179.2 (37.2)
Y	20	60.7 (0.9)	341.2 (8.1)	173.0	184.6 (3.5)
Mo	20	326 (5.3)	2035 (43.0)	408	547 (9.8)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	20	635000 (11000)	666000 (16000)	646200	646165 (11600)
La	20	64.0 (1.10)	194.4 (2.80)	126.1	131.0 (2.10)
Ce	20	185.3 (2.60)	486.5 (7.70)	344.3	342.6 (6.32)
Pr	20	9.5 (0.19)	68.7 (0.98)	40.1	40.1 (0.84)
Nd	20	22.1 (0.59)	339.9 (6.70)	145.1	156.2 (3.73)
Sm	20	3.8 (0.16)	90.6 (1.80)	24.3	33.1 (0.86)
Eu	20	6.13 (0.17)	55.20 (1.30)	18.58	22.75 (0.52)
Gd	20	3.2 (0.16)	77.5 (1.60)	20.0	28.5 (0.76)
Tb	20	0.4 (0.02)	11.2 (0.22)	3.0	4.2 (0.11)
Dy	20	2.8 (0.10)	65.6 (1.50)	20.5	26.0 (0.64)
Ho	20	0.5 (0.03)	10.6 (0.21)	3.7	4.5 (0.10)
Er	20	2.0 (0.06)	24.8 (0.45)	10.1	11.6 (0.25)
Tm	20	0.5 (0.02)	2.7 (0.05)	1.5	1.6 (0.04)
Yb	20	5.0 (0.11)	16.4 (0.33)	8.8	8.8 (0.20)
Lu	20	0.7 (0.02)	1.7 (0.05)	0.9	1.0 (0.03)
∑REE + Y	20	484.6 (3.9)	1485.1 (9.8)	969.6	996.6 (8.0)
$(La/Lu)_{CN}$	20	6.50 (1.40)	29.43 (6.64)	15.04	14.98 (3.24)
$(La/Sm)_{CN}$	20	0.53 (0.11)	31.09 (7.22)	3.42	5.49 (1.22)
$(La/Y)_{CN}$	20	1.25 (0.25)	20.36 (3.31)	5.24	6.55 (1.19)
Eu_A = Eu/Eu*	20	1.42 (0.06)	10.85 (0.79)	2.18	2.96 (0.17)
Ce_A = Ce/Ce*	20	0.68 (0.03)	1.32 (0.06)	1.14	1.12 (0.05)

n.d. = not determined

TABLE B29. Zinnwald – Cínovec, Czech Republic (CMNMC 82045).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	53	≤ LOD	25 (27.0)	8	8 (10.3)
B	122	≤ LOD	42 (7.3)	28	30 (3.3)
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	8	≤ LOD	100 (130.0)	43	48 (133.1)
Ti	71	≤ LOD	43 (25.0)	9	11 (19.1)
V	21	≤ LOD	4 (1.3)	2	2 (2.2)
Cr	14	≤ LOD	28 (46.0)	6	8 (24.5)
Mn	40	≤ LOD	20.0 (17.0)	5.0	6.7 (12.2)
Fe	9	≤ LOD	54 (34.0)	14	18 (27.7)
Co	14	≤ LOD	1.3 (0.4)	1.0	1.0 (1.1)
Ni	39	≤ LOD	17 (34.0)	6	7 (11.8)
Cu	34	≤ LOD	7 (4.2)	4	4 (5.2)
Zn	41	≤ LOD	7 (11.0)	3	3 (4.3)
As	126	178 (22.0)	2320 (700.0)	623	747 (142.7)
Rb	19	≤ LOD	2.5 (3.4)	0.9	1.0 (1.0)
Sr	126	86.0 (13.0)	696.0 (54.0)	250.5	296.6 (42.8)
Y	124	≤ LOD	133.9 (8.9)	12.1	18.1 (4.6)
Mo	126	520 (220.0)	67900 (8600.0)	10050	14601 (2566.6)
Ag	0	≤ LOD	0.7 (0.8)	n.d.	n.d.
Sn	36	≤ LOD	18.0 (16.0)	0.8	1.9 (2.1)
Ba	4	≤ LOD	2 (4.9)	2	2 (2.9)
W	126	533000 (73000)	1130000 (410000)	899000	903635 (112444)
La	120	≤ LOD	19.9 (3.70)	1.6	3.3 (0.92)
Ce	107	≤ LOD	53.0 (18.00)	6.3	11.0 (2.84)
Pr	113	≤ LOD	9.1 (1.60)	0.9	1.4 (0.43)
Nd	105	≤ LOD	42.0 (10.00)	3.9	5.9 (2.18)
Sm	97	≤ LOD	32.0 (14.00)	1.7	2.9 (1.46)
Eu	0	≤ LOD	≤ LOD	n.d.	n.d.
Gd	105	≤ LOD	27.0 (12.00)	1.8	2.7 (1.34)
Tb	99	≤ LOD	4.4 (0.73)	0.5	0.7 (0.29)
Dy	118	≤ LOD	33.2 (9.80)	4.7	5.7 (1.87)
Ho	113	≤ LOD	7.7 (3.40)	1.4	1.5 (0.48)
Er	121	≤ LOD	32.0 (13.00)	5.9	7.0 (1.86)
Tm	116	≤ LOD	7.3 (1.10)	2.1	2.3 (0.58)
Yb	124	≤ LOD	89.0 (8.00)	25.3	27.6 (5.82)
Lu	120	≤ LOD	14.9 (2.90)	4.9	5.4 (1.08)
∑REE + Y	126	0.8 (2.9)	472.2 (45.2)	68.5	89.6 (8.1)
$(La/Lu)_{CN}$	119	n.d.	0.42 (0.25)	0.04	0.07 (0.05)
$(La/Sm)_{CN}$	111	n.d.	5.22 (8.05)	0.91	1.23 (1.26)
$(La/Y)_{CN}$	123	n.d.	3.91 (4.09)	1.13	1.20 (0.96)
Eu_A = Eu/Eu*	4	n.d.	0.05 (0.12)	0.04	0.04 (0.08)
Ce_A = Ce/Ce*	125	n.d.	1.73 (1.20)	1.06	1.07 (0.75)

n.d. = not determined

TABLE B30. The Ovens, NS, Canada (M6-5B).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	32	4.7 (0.9)	13.9 (4.1)	7.2	7.3 (1.0)
Sr	32	534.2 (41.2)	1019.0 (85.2)	823.8	819.1 (57.6)
Y	32	14.3 (0.6)	613.0 (33.3)	125.9	154.5 (18.4)
Nb	17	≤ LOD	5 (0.4)	1	2 (0.3)
Mo	0	≤ LOD	≤ LOD	n.d.	n.d.
Pb	32	13 (2)	28 (2)	18	19 (2)
La	32	6.8 (0.35)	50.2 (3.28)	22.0	22.2 (1.66)
Ce	32	4.4 (0.22)	166.1 (9.56)	38.0	43.3 (3.27)
Pr	32	0.3 (0.04)	32.6 (1.78)	5.5	6.8 (0.51)
Nd	32	0.8 (0.12)	176.5 (8.39)	24.5	33.2 (2.61)
Sm	31	≤ LOD	99.5 (5.16)	13.1	19.3 (1.75)
Eu	32	32.11 (2.27)	155.51 (6.03)	70.24	71.27 (4.70)
Gd	32	0.5 (0.10)	158.3 (11.74)	20.0	29.8 (3.12)
Tb	31	≤ LOD	25.0 (1.64)	3.5	4.9 (0.56)
Dy	32	0.5 (0.09)	133.2 (9.65)	19.2	26.3 (3.31)
Ho	31	≤ LOD	20.6 (1.39)	3.2	4.4 (0.53)
Er	32	0.5 (0.06)	52.1 (3.47)	9.0	11.8 (1.51)
Tm	31	≤ LOD	6.7 (0.41)	1.5	1.7 (0.24)
Yb	32	2.0 (0.19)	36.0 (2.08)	9.7	11.4 (1.80)
Lu	31	≤ LOD	3.5 (0.17)	1.3	1.4 (0.19)
∑REE + Y	32	63.2 (2.3)	1728.8 (22.2)	365.8	441.4 (9.3)
$(La/Lu)_{CN}$	32	0.80 (1.00)	2.15 (0.61)	1.78	1.75 (0.64)
$(La/Sm)_{CN}$	32	0.32 (0.11)	18.65 (8.46)	0.99	1.71 (0.68)
$(La/Y)_{CN}$	32	0.37 (0.41)	3.16 (0.95)	1.10	1.20 (0.42)
$Eu_A = Eu/Eu^*$	32	3.75 (0.39)	274.87 (76.34)	11.66	23.25 (4.64)
$Ce_A = Ce/Ce^*$	32	0.44 (0.05)	0.95 (0.10)	0.81	0.80 (0.11)

n.d. = not determined

TABLE B31. Barewood, New Zealand (M6616).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	1	≤ LOD	1.5 (0.4)	1.5	1.5 (0.4)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	1	≤ LOD	3 (0.5)	3	3 (0.5)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	3037.0 (27.0)	6090.0 (130.0)	4403.0	4534.6 (75.6)
Y	20	18.6 (0.4)	126.0 (18.0)	37.1	46.3 (2.3)
Mo	0	≤ LOD	≤ LOD	n.d.	n.d.
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	1	≤ LOD	2 (0.2)	2	2 (0.2)
W	20	767000 (12000)	799000 (12000)	780500	779450 (12600)
La	20	6.2 (0.10)	24.4 (2.70)	10.3	12.0 (0.41)
Ce	20	8.0 (0.15)	79.0 (12.00)	22.2	26.8 (1.53)
Pr	20	0.7 (0.03)	10.8 (1.80)	2.3	3.1 (0.23)
Nd	20	2.2 (0.11)	46.4 (7.90)	9.4	12.8 (1.01)
Sm	19	≤ LOD	9.6 (1.70)	1.9	2.7 (0.26)
Eu	20	1.15 (0.05)	7.83 (0.68)	2.39	3.12 (0.18)
Gd	20	0.4 (0.06)	9.8 (1.70)	2.0	2.8 (0.26)
Tb	16	≤ LOD	1.5 (0.27)	0.4	0.5 (0.05)
Dy	20	0.6 (0.04)	11.6 (2.00)	2.4	3.4 (0.28)
Ho	19	≤ LOD	2.9 (0.48)	0.7	0.9 (0.07)
Er	20	1.0 (0.07)	10.9 (1.70)	2.7	3.4 (0.24)
Tm	19	≤ LOD	1.7 (0.24)	0.5	0.6 (0.04)
Yb	20	2.7 (0.09)	11.3 (1.30)	4.4	5.0 (0.23)
Lu	19	≤ LOD	1.9 (0.18)	0.9	1.0 (0.04)
∑REE + Y	20	43.9 (0.3)	355.4 (15.3)	101.4	124.3 (2.0)
$(La/Lu)_{CN}$	20	1.01 (0.25)	1.70 (0.42)	1.27	1.29 (0.33)
$(La/Sm)_{CN}$	20	1.49 (0.36)	11.05 (4.30)	3.52	4.43 (1.47)
$(La/Y)_{CN}$	20	1.29 (0.65)	2.45 (0.63)	1.76	1.83 (0.40)
Eu_A = Eu/Eu*	20	2.00 (0.14)	8.68 (1.24)	4.25	4.51 (0.61)
Ce_A = Ce/Ce*	20	0.74 (0.04)	1.16 (0.30)	0.98	0.99 (0.08)

n.d. = not determined

TABLE B32. Kovárna Mine (Obří dul, Riesengrund), Czech Republic (M6917).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0	≤ LOD	≤ LOD	n.d.	n.d.
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	1	≤ LOD	1 (0.1)	1	1 (0.1)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	38.6 (0.5)	268.6 (5.1)	149.5	145.5 (2.7)
Y	20	0.7 (0.0)	128.5 (2.3)	6.9	17.6 (0.4)
Mo	20	4 (0.2)	240 (3.5)	16	40 (0.8)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	20	653000 (12000)	691000 (15000)	676250	675585 (11995)
La	20	0.7 (0.04)	102.4 (1.40)	5.1	25.3 (0.37)
Ce	18	≤ LOD	182.8 (3.60)	25.9	40.3 (0.76)
Pr	18	≤ LOD	14.8 (0.36)	2.0	3.4 (0.09)
Nd	19	≤ LOD	38.3 (1.10)	3.6	9.9 (0.35)
Sm	14	≤ LOD	10.7 (0.55)	1.1	2.5 (0.14)
Eu	20	0.14 (0.02)	21.51 (0.36)	1.71	4.56 (0.11)
Gd	16	≤ LOD	13.1 (0.70)	0.9	2.3 (0.14)
Tb	8	≤ LOD	2.1 (0.10)	0.5	0.6 (0.03)
Dy	13	≤ LOD	14.1 (0.65)	1.3	2.8 (0.14)
Ho	7	≤ LOD	2.7 (0.10)	0.7	0.9 (0.04)
Er	11	≤ LOD	7.1 (0.27)	0.8	1.8 (0.07)
Tm	3	≤ LOD	0.8 (0.02)	0.8	0.6 (0.02)
Yb	10	≤ LOD	7.4 (0.17)	1.0	1.9 (0.08)
Lu	1	≤ LOD	1.5 (0.04)	1.5	1.5 (0.04)
∑REE + Y	20	3.3 (0.1)	392.9 (4.1)	50.8	105.0 (0.9)
$(La/Lu)_{CN}$	20	2.43 (0.67)	331.41 (122.15)	11.31	62.94 (26.13)
$(La/Sm)_{CN}$	20	0.45 (0.11)	73.52 (26.88)	7.19	17.07 (6.15)
$(La/Y)_{CN}$	20	0.78 (0.15)	262.66 (58.10)	3.45	54.33 (11.85)
$Eu_A = Eu/Eu^*$	20	0.64 (0.14)	156.68 (126.39)	6.54	18.19 (7.76)
$Ce_A = Ce/Ce^*$	20	0.50 (0.04)	1.07 (0.06)	0.82	0.81 (0.05)

n.d. = not determined

TABLE B33. Mackenzie Mine, ON, Canada (ME736).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	15	≤ LOD	7 (0.3)	3	4 (0.3)
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	20	1.8 (0.2)	9.1 (0.3)	5.2	5.6 (0.3)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	18	≤ LOD	9 (0.5)	3	3 (0.2)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	20	845.4 (7.1)	1100.0 (14.0)	1007.5	990.7 (11.1)
Y	20	145.2 (3.2)	1270.0 (390.0)	430.1	434.5 (26.6)
Mo	20	2 (0.1)	4 (0.2)	3	3 (0.2)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	20	643400 (8700)	673200 (7500)	652950	655115 (8285)
La	20	5.6 (0.29)	30.2 (0.38)	16.3	16.3 (0.81)
Ce	20	23.7 (0.51)	107.3 (2.20)	65.7	66.2 (2.35)
Pr	20	2.3 (0.06)	20.2 (1.10)	12.1	12.1 (0.36)
Nd	20	8.7 (0.20)	125.9 (4.10)	79.1	75.2 (1.85)
Sm	20	3.7 (0.14)	79.4 (8.50)	34.7	36.6 (1.17)
Eu	20	19.99 (0.31)	53.13 (0.68)	39.37	37.40 (0.65)
Gd	20	5.9 (0.17)	206.0 (32.00)	57.0	67.5 (2.66)
Tb	20	1.3 (0.03)	47.2 (9.90)	12.3	13.9 (0.71)
Dy	20	11.6 (0.26)	375.0 (91.00)	85.0	101.6 (6.08)
Ho	20	2.7 (0.06)	67.0 (17.00)	15.9	18.3 (1.13)
Er	20	11.2 (0.26)	141.0 (39.00)	46.4	45.1 (2.62)
Tm	20	1.8 (0.05)	14.6 (4.40)	5.5	5.6 (0.32)
Yb	20	6.5 (0.17)	60.0 (20.00)	29.5	28.2 (1.64)
Lu	19	≤ LOD	4.2 (0.08)	3.0	2.8 (0.13)
∑REE + Y	20	286.1 (1.1)	2442.2 (108.4)	1015.2	961.2 (9.3)
$(La/Lu)_{CN}$	20	0.18 (0.13)	1.47 (0.42)	0.68	0.69 (0.19)
$(La/Sm)_{CN}$	20	0.05 (0.03)	2.67 (0.65)	0.37	0.57 (0.14)
$(La/Y)_{CN}$	20	0.04 (0.02)	0.73 (0.15)	0.31	0.30 (0.07)
Eu_A = Eu/Eu*	20	0.70 (0.16)	17.46 (0.95)	3.49	4.36 (0.23)
Ce_A = Ce/Ce*	20	0.81 (0.12)	1.19 (0.06)	1.07	1.05 (0.08)

n.d. = not determined

TABLE B34. Silverton, Colorado, USA (ME747).

Sample (ppm)	Count (above LOD)	Min	Max	Median	Mean
Li	0	≤ LOD	≤ LOD	n.d.	n.d.
B	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	0	≤ LOD	≤ LOD	n.d.	n.d.
K	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	0	≤ LOD	≤ LOD	n.d.	n.d.
V	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	15	18.6 (0.4)	39.6 (0.6)	30.2	30.5 (0.6)
Fe	0	≤ LOD	≤ LOD	n.d.	n.d.
Co	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	0	≤ LOD	≤ LOD	n.d.	n.d.
Zn	0	≤ LOD	≤ LOD	n.d.	n.d.
As	11	≤ LOD	5 (0.3)	1	2 (0.1)
Rb	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	15	958.0 (11.0)	1771.0 (18.0)	1642.0	1612.9 (17.7)
Y	15	112.5 (1.6)	221.7 (2.1)	168.5	167.3 (1.8)
Mo	15	177 (2.4)	219 (2.5)	204	203 (2.9)
Ag	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	0	≤ LOD	≤ LOD	n.d.	n.d.
Ba	0	≤ LOD	≤ LOD	n.d.	n.d.
W	15	730000 (11000)	767000 (10000)	759000	754547 (9720)
La	15	15.2 (0.20)	115.3 (1.40)	91.6	83.7 (0.95)
Ce	15	104.7 (1.30)	256.4 (3.30)	189.2	185.0 (2.28)
Pr	15	13.4 (0.21)	29.3 (0.34)	22.0	22.0 (0.28)
Nd	15	54.0 (0.84)	160.5 (2.30)	86.5	86.8 (1.19)
Sm	15	9.1 (0.22)	56.8 (0.77)	18.9	20.3 (0.35)
Eu	15	10.72 (0.17)	31.54 (0.43)	14.05	15.45 (0.22)
Gd	15	7.3 (0.19)	54.9 (0.91)	16.6	18.2 (0.36)
Tb	15	1.6 (0.03)	8.4 (0.12)	3.8	3.7 (0.06)
Dy	15	17.7 (0.21)	53.6 (0.67)	37.7	36.2 (0.51)
Ho	15	5.0 (0.08)	12.3 (0.15)	9.7	9.2 (0.12)
Er	15	23.5 (0.35)	48.8 (0.52)	37.9	36.7 (0.43)
Tm	15	3.7 (0.06)	10.1 (0.12)	8.4	7.8 (0.10)
Yb	15	20.6 (0.30)	83.9 (0.89)	69.5	62.5 (0.79)
Lu	15	2.0 (0.04)	11.2 (0.12)	9.0	8.1 (0.11)
∑REE + Y	15	478.6 (2.0)	937.8 (3.8)	804.8	763.0 (3.1)
$(La/Lu)_{CN}$	15	0.76 (0.14)	1.55 (0.24)	1.06	1.07 (0.17)
$(La/Sm)_{CN}$	15	0.17 (0.03)	6.16 (1.11)	2.87	3.12 (0.55)
$(La/Y)_{CN}$	15	0.46 (0.07)	4.73 (0.64)	3.38	3.41 (0.51)
Eu_A = Eu/Eu*	15	1.69 (0.06)	3.88 (0.18)	2.40	2.61 (0.11)
Ce_A = Ce/Ce*	15	0.98 (0.04)	1.06 (0.05)	1.02	1.02 (0.04)

n.d. = not determined

Appendix C: Major and trace element compositions of the analysed scheelite samples from various deposits.

TABLE C1. Sisson W-Mo Deposit, NB, Canada (11-MPB-SB).

Sample (ppm)	Sisson_S_1	Sisson_S_2	Sisson_S_3	Sisson_S_4	Sisson_S_5	Sisson_S_6	Sisson_S_7	Sisson_S_8	Sisson_S_9
Li	2 (0.1)	3 (0.2)	≤ LOD	4 (0.2)	3 (0.2)	2 (0.3)	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (0.5)	2 (0.3)	≤ LOD
V	2 (0.1)	3 (0.1)	3 (0.1)	2 (0.1)	2 (0.1)	3 (0.1)	6 (0.3)	7 (0.2)	7 (0.3)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	58.6 (1.7)	80.0 (2.5)	81.4 (2.7)	79.9 (2.7)	79.5 (2.2)	50.6 (1.6)	27.2 (1.1)	33.7 (0.9)	36.0 (1.1)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (6.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	6 (0.3)	7 (0.3)	7 (0.4)	7 (0.3)	6 (0.3)	7 (0.3)	9 (0.4)	9 (0.3)	10 (0.4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	107.6 (3.0)	114.1 (3.7)	111.2 (3.8)	103.0 (3.1)	102.8 (2.5)	96.0 (2.6)	91.7 (2.9)	68.5 (1.7)	66.8 (1.7)
Y	528.0 (15.0)	782.0 (25.0)	759.0 (22.0)	860.0 (26.0)	754.0 (19.0)	828.0 (24.0)	1233.0 (48.0)	1247.0 (31.0)	1385.0 (39.0)
Mo	4350 (120.0)	4000 (130.0)	3920 (130.0)	3660 (110.0)	3840 (100.0)	2560 (110.0)	4010 (120.0)	6370 (160.0)	5820 (180.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	667000 (36000)	660000 (39000)	659000 (37000)	675000 (37000)	689000 (35000)	696000 (38000)	697000 (38000)	688000 (37000)	696000 (40000)
La	200.5 (5.80)	286.5 (9.30)	270.8 (8.30)	268.9 (7.80)	216.6 (5.50)	178.5 (5.20)	139.9 (5.00)	169.9 (4.20)	192.5 (5.60)
Ce	704.0 (21.00)	996.0 (32.00)	946.0 (29.00)	995.0 (33.00)	800.0 (20.00)	607.0 (16.00)	614.0 (22.00)	711.0 (19.00)	796.0 (22.00)
Pr	110.1 (3.40)	160.0 (5.00)	150.8 (4.60)	163.1 (5.10)	130.8 (3.40)	103.5 (3.00)	130.0 (4.60)	137.7 (3.70)	153.9 (4.50)
Nd	472.0 (13.00)	711.0 (23.00)	682.0 (22.00)	713.0 (22.00)	607.0 (15.00)	563.0 (16.00)	815.0 (29.00)	784.0 (21.00)	870.0 (26.00)
Sm	97.7 (2.90)	155.6 (5.00)	152.6 (5.20)	153.7 (4.60)	142.3 (3.80)	175.4 (5.30)	291.7 (9.30)	239.8 (5.90)	272.1 (6.90)
Eu	16.88 (0.46)	26.35 (0.82)	26.54 (0.90)	27.26 (0.83)	21.32 (0.59)	23.01 (0.76)	7.43 (0.28)	8.77 (0.23)	8.72 (0.25)
Gd	76.7 (2.30)	136.7 (4.40)	134.0 (4.20)	127.1 (3.90)	126.0 (3.30)	200.2 (6.60)	331.0 (12.00)	246.6 (6.00)	280.9 (8.40)
Tb	13.6 (0.40)	23.0 (0.71)	22.2 (0.75)	22.7 (0.65)	21.2 (0.56)	32.5 (1.10)	53.2 (2.00)	42.2 (1.10)	47.7 (1.40)
Dy	96.8 (2.80)	158.4 (5.30)	153.3 (4.70)	164.5 (5.00)	148.1 (3.80)	209.4 (6.80)	345.0 (14.00)	288.4 (7.40)	325.3 (9.70)
Ho	19.4 (0.54)	30.7 (1.00)	30.1 (0.93)	32.7 (1.00)	29.8 (0.72)	39.7 (1.30)	63.0 (2.50)	55.9 (1.40)	62.3 (1.80)
Er	61.4 (1.80)	92.5 (2.80)	90.2 (2.50)	103.3 (3.30)	90.1 (2.60)	101.5 (3.20)	155.8 (5.80)	150.0 (3.70)	168.1 (4.80)
Tm	10.0 (0.29)	14.5 (0.45)	14.5 (0.41)	17.1 (0.53)	14.4 (0.39)	13.1 (0.40)	18.7 (0.73)	20.1 (0.53)	22.2 (0.63)
Yb	66.1 (1.80)	95.4 (3.20)	96.7 (2.70)	114.5 (3.50)	96.3 (2.50)	75.1 (2.20)	96.8 (4.40)	110.2 (2.80)	122.8 (3.80)
Lu	8.4 (0.24)	12.3 (0.40)	12.7 (0.41)	14.8 (0.48)	12.6 (0.32)	9.2 (0.24)	10.8 (0.44)	12.7 (0.36)	14.1 (0.41)
∑REE + Y	2481.5 (26.2)	3681.0 (41.9)	3541.5 (38.7)	3777.7 (41.8)	3210.6 (26.9)	3159.1 (26.2)	4305.3 (43.1)	4224.2 (31.4)	4721.6 (38.3)
$(La/Lu)_{CN}$	2.47 (0.59)	2.41 (0.62)	2.21 (0.55)	1.88 (0.47)	1.78 (0.40)	2.00 (0.47)	1.34 (0.37)	1.39 (0.32)	1.41 (0.34)
$(La/Sm)_{CN}$	1.29 (0.31)	1.15 (0.29)	1.11 (0.28)	1.10 (0.27)	0.95 (0.22)	0.64 (0.16)	0.30 (0.08)	0.44 (0.10)	0.44 (0.10)
$(La/Y)_{CN}$	2.52 (0.60)	2.44 (0.62)	2.37 (0.58)	2.08 (0.51)	1.91 (0.43)	1.43 (0.35)	0.75 (0.21)	0.91 (0.20)	0.92 (0.22)
$Eu_A = Eu/Eu^*$	0.57 (0.03)	0.54 (0.03)	0.55 (0.04)	0.58 (0.03)	0.47 (0.03)	0.37 (0.02)	0.07 (0.00)	0.11 (0.01)	0.09 (0.01)
$Ce_A = Ce/Ce^*$	1.12 (0.07)	1.09 (0.07)	1.10 (0.07)	1.11 (0.07)	1.11 (0.06)	1.05 (0.06)	0.99 (0.08)	1.04 (0.06)	1.04 (0.07)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_10	Sisson_S_11	Sisson_S_12	Sisson_S_13	Sisson_S_14	Sisson_S_15	Sisson_S_16	Sisson_S_17	Sisson_S_18
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	3 (0.3)	≤ LOD	2 (0.3)	≤ LOD	≤ LOD	3 (0.2)	≤ LOD	10 (7.9)	≤ LOD
V	7 (0.2)	7 (0.2)	6 (0.2)	7 (0.3)	7 (0.2)	7 (0.2)	6 (0.2)	6 (0.3)	5 (0.2)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	44.5 (1.6)	39.0 (1.0)	40.5 (1.7)	43.9 (1.7)	41.0 (1.3)	34.0 (0.9)	32.6 (0.9)	34.3 (1.7)	31.5 (1.0)
Fe	≤ LOD	173 (14.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	111 (15.0)	67 (56.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	10 (0.5)	9 (0.4)	9 (0.4)	8 (0.4)	9 (0.3)	9 (0.4)	8 (0.4)	6 (0.3)	6 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.5)	≤ LOD
Sr	87.5 (3.0)	69.0 (1.8)	77.2 (2.6)	68.9 (2.1)	66.3 (1.9)	138.5 (3.7)	142.4 (3.9)	142.7 (4.2)	122.1 (3.5)
Y	1561.0 (48.0)	1209.0 (33.0)	1122.0 (42.0)	1178.0 (36.0)	1367.0 (41.0)	1575.0 (44.0)	1443.0 (40.0)	996.0 (33.0)	888.0 (27.0)
Mo	4680 (140.0)	6450 (200.0)	6300 (210.0)	6100 (200.0)	6370 (200.0)	3657 (97.0)	3510 (100.0)	4520 (160.0)	3690 (120.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	695000 (38000)	690000 (40000)	708000 (40000)	691000 (37000)	694000 (39000)	718000 (37000)	710000 (41000)	709000 (41000)	693000 (41000)
La	175.6 (5.30)	172.1 (5.00)	162.5 (5.20)	166.0 (5.30)	172.9 (4.90)	122.8 (3.30)	113.4 (3.30)	80.9 (2.30)	101.9 (3.00)
Ce	751.0 (22.00)	706.0 (23.00)	657.0 (20.00)	671.0 (22.00)	710.0 (21.00)	567.0 (16.00)	514.0 (15.00)	378.0 (11.00)	434.0 (13.00)
Pr	154.3 (4.60)	137.0 (4.00)	128.5 (3.90)	130.3 (4.30)	139.3 (4.00)	122.2 (3.40)	111.9 (3.10)	76.4 (2.30)	89.2 (2.90)
Nd	980.0 (30.00)	774.0 (22.00)	748.0 (25.00)	757.0 (25.00)	822.0 (24.00)	824.0 (23.00)	753.0 (23.00)	512.0 (17.00)	560.0 (18.00)
Sm	348.0 (11.00)	240.8 (6.40)	238.5 (8.40)	249.0 (7.90)	273.4 (7.90)	314.0 (8.60)	289.9 (9.00)	194.5 (6.00)	197.0 (6.60)
Eu	9.20 (0.32)	8.88 (0.24)	8.65 (0.26)	8.61 (0.28)	9.00 (0.29)	11.66 (0.35)	10.52 (0.31)	8.44 (0.27)	8.92 (0.28)
Gd	395.0 (12.00)	242.7 (6.50)	241.4 (7.60)	257.0 (8.80)	288.2 (8.80)	386.0 (11.00)	352.0 (10.00)	246.0 (9.00)	219.5 (7.10)
Tb	65.0 (2.10)	41.5 (1.20)	41.0 (1.50)	43.9 (1.60)	49.6 (1.30)	64.2 (1.60)	58.6 (1.60)	41.0 (1.40)	36.0 (1.20)
Dy	428.0 (15.00)	280.1 (7.40)	271.7 (9.30)	293.1 (9.40)	335.7 (9.90)	425.0 (12.00)	390.0 (10.00)	266.2 (9.40)	236.1 (7.30)
Ho	78.7 (2.50)	53.8 (1.50)	51.0 (1.90)	54.4 (1.80)	62.3 (1.90)	80.2 (2.20)	73.0 (2.20)	49.6 (1.90)	43.2 (1.30)
Er	198.6 (7.00)	145.8 (4.40)	136.9 (5.60)	145.9 (5.10)	165.1 (4.60)	207.4 (5.50)	186.8 (5.40)	128.9 (4.70)	112.5 (3.30)
Tm	24.1 (0.80)	19.0 (0.55)	17.8 (0.84)	18.8 (0.62)	21.3 (0.58)	23.8 (0.63)	21.7 (0.58)	14.7 (0.49)	13.5 (0.41)
Yb	124.3 (3.80)	106.2 (3.20)	97.2 (5.40)	102.9 (3.60)	115.0 (3.30)	119.0 (3.30)	109.6 (3.20)	74.5 (2.50)	69.4 (2.10)
Lu	13.7 (0.45)	12.0 (0.37)	10.8 (0.58)	11.8 (0.39)	12.9 (0.39)	13.1 (0.34)	12.0 (0.37)	8.3 (0.30)	7.6 (0.25)
∑REE + Y	5306.5 (44.7)	4148.9 (35.0)	3933.0 (36.7)	4087.6 (37.8)	4543.7 (36.5)	4855.3 (34.6)	4439.4 (33.2)	3075.5 (25.7)	3016.8 (26.0)
$(La/Lu)_{CN}$	1.33 (0.33)	1.49 (0.36)	1.55 (0.45)	1.46 (0.37)	1.39 (0.34)	0.97 (0.22)	0.98 (0.24)	1.00 (0.25)	1.39 (0.35)
$(La/Sm)_{CN}$	0.32 (0.08)	0.45 (0.11)	0.43 (0.11)	0.42 (0.11)	0.40 (0.09)	0.25 (0.06)	0.25 (0.06)	0.26 (0.06)	0.32 (0.08)
$(La/Y)_{CN}$	0.75 (0.18)	0.95 (0.22)	0.96 (0.25)	0.94 (0.23)	0.84 (0.20)	0.52 (0.12)	0.52 (0.12)	0.54 (0.13)	0.76 (0.19)
$Eu_A = Eu/Eu^*$	0.08 (0.00)	0.11 (0.01)	0.11 (0.01)	0.10 (0.01)	0.10 (0.01)	0.10 (0.01)	0.10 (0.01)	0.12 (0.01)	0.13 (0.01)
$Ce_A = Ce/Ce^*$	1.00 (0.07)	1.03 (0.07)	1.02 (0.07)	1.03 (0.07)	1.02 (0.07)	0.99 (0.06)	0.98 (0.06)	1.04 (0.07)	1.00 (0.07)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_19	Sisson_S_20	Sisson_S_21	Sisson_S_22	Sisson_S_23	Sisson_S_24	Sisson_S_25	Sisson_S_26	Sisson_S_27
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	2 (0.2)	7 (0.3)	5 (0.2)	6 (0.2)	2 (0.1)	4 (0.1)	6 (0.2)	4 (0.2)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	21.0 (0.7)	23.6 (0.9)	22.8 (0.8)	22.8 (0.6)	22.6 (0.7)	21.9 (0.8)	24.9 (1.0)	24.4 (1.0)	39.5 (1.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (4.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	4 (0.3)	4 (0.3)	8 (0.5)	7 (0.3)	7 (0.3)	4 (0.2)	5 (0.2)	7 (0.3)	7 (0.4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	116.4 (3.5)	140.0 (4.6)	145.8 (4.7)	142.0 (3.8)	100.8 (3.0)	142.4 (3.8)	133.9 (4.4)	111.8 (3.8)	137.6 (5.2)
Y	714.0 (21.0)	558.0 (26.0)	1160.0 (34.0)	987.0 (28.0)	1075.0 (30.0)	548.0 (15.0)	767.0 (23.0)	1031.0 (34.0)	884.0 (30.0)
Mo	1031 (73.0)	2561 (77.0)	4450 (160.0)	3846 (99.0)	4840 (160.0)	4530 (130.0)	5200 (160.0)	4400 (170.0)	8110 (270.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	702000 (38000)	669000 (36000)	670000 (40000)	665000 (39000)	670000 (40000)	662000 (40000)	720000 (44000)	715000 (46000)	678000 (46000)
La	57.9 (1.80)	36.2 (1.10)	49.1 (1.70)	41.8 (1.10)	110.9 (3.60)	31.4 (0.92)	68.7 (2.30)	111.5 (3.90)	139.8 (4.80)
Ce	297.2 (9.80)	154.9 (5.40)	220.0 (7.20)	213.1 (6.10)	493.0 (16.00)	137.9 (3.80)	300.1 (9.90)	489.0 (17.00)	602.0 (22.00)
Pr	65.7 (2.30)	31.2 (1.20)	46.8 (1.60)	49.2 (1.40)	102.0 (3.20)	28.3 (0.84)	57.4 (1.90)	100.8 (3.40)	110.2 (3.90)
Nd	479.0 (16.00)	205.6 (8.80)	339.0 (11.00)	375.1 (9.80)	643.0 (21.00)	190.3 (5.30)	372.0 (12.00)	640.0 (24.00)	611.0 (20.00)
Sm	219.7 (6.90)	85.9 (3.90)	153.4 (4.90)	163.4 (4.30)	226.7 (8.00)	82.8 (2.30)	144.7 (4.70)	224.6 (6.40)	178.7 (6.40)
Eu	26.58 (0.88)	10.23 (0.38)	13.11 (0.45)	15.31 (0.46)	8.76 (0.28)	7.72 (0.24)	7.47 (0.25)	8.32 (0.29)	16.99 (0.58)
Gd	298.1 (9.40)	122.5 (5.60)	242.3 (8.10)	240.3 (6.70)	256.1 (8.40)	120.4 (3.10)	191.3 (6.40)	258.5 (8.50)	183.7 (6.30)
Tb	46.4 (1.30)	20.5 (0.92)	41.4 (1.30)	39.6 (0.98)	42.6 (1.40)	20.6 (0.56)	31.1 (0.99)	42.4 (1.40)	30.1 (1.10)
Dy	266.1 (8.00)	137.4 (6.40)	288.8 (9.10)	265.2 (7.40)	285.0 (9.00)	141.0 (4.00)	203.8 (6.30)	277.0 (9.80)	202.5 (7.00)
Ho	41.5 (1.30)	26.9 (1.40)	58.3 (1.90)	50.6 (1.30)	52.4 (1.70)	26.9 (0.70)	38.3 (1.20)	51.6 (1.80)	40.4 (1.40)
Er	90.7 (2.70)	67.4 (3.20)	151.2 (5.00)	129.3 (3.40)	135.7 (4.10)	69.4 (1.80)	96.9 (2.80)	133.2 (4.60)	107.5 (3.70)
Tm	9.5 (0.29)	7.8 (0.35)	16.2 (0.51)	13.8 (0.38)	16.6 (0.50)	7.8 (0.21)	11.2 (0.37)	15.8 (0.54)	14.3 (0.47)
Yb	45.4 (1.40)	39.4 (1.70)	78.3 (2.60)	66.6 (1.90)	87.6 (2.80)	38.8 (1.10)	56.4 (1.90)	81.9 (3.00)	77.8 (2.70)
Lu	4.8 (0.14)	4.4 (0.22)	9.0 (0.28)	7.4 (0.21)	9.7 (0.28)	4.2 (0.12)	6.2 (0.20)	9.1 (0.30)	9.1 (0.33)
∑REE + Y	2662.5 (24.0)	1508.3 (14.6)	2867.0 (19.7)	2657.7 (16.5)	3545.1 (31.1)	1455.5 (9.0)	2352.6 (19.2)	3474.8 (33.7)	3208.1 (32.8)
$(La/Lu)_{CN}$	1.26 (0.31)	0.85 (0.24)	0.56 (0.14)	0.59 (0.14)	1.19 (0.29)	0.77 (0.19)	1.15 (0.29)	1.27 (0.33)	1.59 (0.42)
$(La/Sm)_{CN}$	0.17 (0.04)	0.26 (0.07)	0.20 (0.05)	0.16 (0.04)	0.31 (0.08)	0.24 (0.06)	0.30 (0.08)	0.31 (0.08)	0.49 (0.13)
$(La/Y)_{CN}$	0.54 (0.13)	0.43 (0.12)	0.28 (0.07)	0.28 (0.07)	0.69 (0.17)	0.38 (0.09)	0.60 (0.15)	0.72 (0.19)	1.05 (0.27)
$Eu_A = Eu/Eu^*$	0.32 (0.02)	0.30 (0.02)	0.21 (0.01)	0.23 (0.01)	0.11 (0.01)	0.23 (0.01)	0.14 (0.01)	0.10 (0.01)	0.28 (0.02)
$Ce_A = Ce/Ce^*$	1.00 (0.08)	1.02 (0.08)	0.99 (0.07)	0.97 (0.07)	1.01 (0.07)	1.01 (0.07)	1.06 (0.08)	1.01 (0.07)	1.09 (0.08)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_28	Sisson_S_29	Sisson_S_30	Sisson_S_31	Sisson_S_32	Sisson_S_33	Sisson_S_34	Sisson_S_35	Sisson_S_36
Li	3 (0.2)	1 (0.2)	≤ LOD	1 (0.4)	≤ LOD	≤ LOD	2 (0.2)	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	79 (24.0)	≤ LOD	≤ LOD	97 (9.3)	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (0.4)	5 (0.4)	≤ LOD	≤ LOD
V	6 (0.2)	5 (0.2)	4 (0.2)	4 (0.1)	4 (0.1)	4 (0.2)	4 (0.2)	3 (0.2)	4 (0.1)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	65.9 (2.1)	50.5 (1.7)	30.8 (1.2)	30.8 (1.9)	26.5 (0.8)	23.6 (0.7)	29.7 (1.5)	32.2 (1.3)	42.6 (1.3)
Fe	6 (9.1)	≤ LOD	≤ LOD	131 (37.0)	≤ LOD	27 (5.5)	174 (17.0)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	2.2 (0.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	9 (0.4)	8 (0.4)	7 (0.3)	7 (0.5)	6 (0.3)	9 (0.4)	11 (0.6)	6 (0.3)	5 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	2.0 (0.5)	≤ LOD	0.7 (0.1)	2.2 (0.2)	≤ LOD	≤ LOD
Sr	140.8 (4.0)	143.5 (4.5)	148.7 (5.2)	148.8 (5.7)	144.0 (4.9)	142.3 (3.8)	146.2 (5.3)	144.8 (4.5)	148.6 (4.6)
Y	1006.0 (36.0)	957.0 (29.0)	863.0 (26.0)	519.0 (17.0)	592.0 (18.0)	606.0 (19.0)	603.0 (20.0)	546.0 (18.0)	458.0 (13.0)
Mo	9050 (360.0)	8630 (240.0)	8300 (270.0)	9410 (330.0)	9950 (310.0)	8110 (240.0)	7020 (250.0)	9360 (310.0)	10020 (310.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	685000 (41000)	680000 (42000)	686000 (46000)	667000 (42000)	688000 (42000)	689000 (41000)	690000 (42000)	736000 (49000)	713000 (40000)
La	176.6 (5.50)	180.2 (5.70)	180.6 (5.60)	147.0 (14.00)	102.8 (3.20)	76.8 (2.20)	58.7 (2.20)	102.4 (3.30)	103.0 (3.00)
Ce	747.0 (23.00)	742.0 (21.00)	753.0 (23.00)	546.0 (41.00)	442.0 (15.00)	345.7 (9.10)	266.5 (9.20)	428.0 (14.00)	397.0 (12.00)
Pr	137.6 (4.20)	135.7 (4.10)	134.1 (4.20)	86.8 (6.00)	76.1 (2.50)	61.4 (1.70)	49.4 (1.80)	71.5 (2.50)	62.3 (2.00)
Nd	736.0 (23.00)	707.0 (21.00)	674.0 (20.00)	413.0 (24.00)	399.0 (12.00)	344.7 (9.70)	282.0 (10.00)	365.0 (14.00)	311.3 (9.40)
Sm	204.0 (5.80)	197.5 (6.10)	175.1 (5.50)	103.2 (4.40)	111.2 (3.90)	105.5 (3.10)	90.4 (3.30)	98.2 (3.40)	83.5 (2.70)
Eu	21.61 (0.65)	21.09 (0.63)	23.07 (0.75)	13.91 (0.50)	14.70 (0.50)	10.52 (0.30)	9.31 (0.34)	12.26 (0.41)	10.86 (0.35)
Gd	204.2 (6.60)	190.4 (5.80)	161.2 (4.80)	96.9 (3.40)	112.0 (3.80)	119.4 (3.50)	104.8 (3.80)	93.5 (3.40)	78.5 (2.30)
Tb	33.3 (1.10)	31.5 (1.00)	26.9 (0.85)	16.0 (0.57)	18.7 (0.60)	20.5 (0.64)	19.4 (0.71)	16.4 (0.60)	13.3 (0.40)
Dy	224.4 (6.90)	212.0 (6.60)	186.7 (6.00)	110.3 (3.80)	128.3 (4.10)	142.1 (4.40)	140.9 (5.40)	116.0 (4.20)	92.3 (2.70)
Ho	44.3 (1.40)	42.5 (1.30)	36.8 (1.10)	22.3 (0.80)	25.9 (0.81)	28.4 (0.94)	28.5 (1.00)	22.2 (0.75)	17.6 (0.54)
Er	121.3 (3.80)	115.0 (3.80)	104.8 (3.40)	61.5 (2.30)	72.0 (2.30)	77.5 (2.50)	80.3 (2.80)	65.5 (2.40)	50.3 (1.50)
Tm	16.2 (0.53)	15.6 (0.51)	15.1 (0.45)	8.6 (0.28)	9.7 (0.31)	10.3 (0.35)	11.0 (0.38)	9.2 (0.33)	7.0 (0.21)
Yb	89.3 (3.50)	84.6 (2.70)	88.8 (2.80)	48.1 (1.70)	54.2 (1.70)	58.3 (2.00)	63.5 (2.20)	53.8 (2.00)	40.3 (1.20)
Lu	10.7 (0.40)	10.0 (0.31)	10.6 (0.37)	5.7 (0.19)	6.5 (0.21)	7.2 (0.25)	8.3 (0.26)	6.3 (0.23)	4.7 (0.14)
∑REE + Y	3772.6 (35.5)	3642.0 (32.7)	3433.8 (33.0)	2198.2 (50.4)	2165.0 (21.0)	2014.4 (15.4)	1815.9 (16.2)	2006.3 (21.5)	1729.8 (16.4)
$(La/Lu)_{CN}$	1.70 (0.45)	1.87 (0.47)	1.76 (0.45)	2.66 (0.95)	1.64 (0.41)	1.10 (0.28)	0.74 (0.19)	1.67 (0.44)	2.29 (0.56)
$(La/Sm)_{CN}$	0.54 (0.13)	0.57 (0.14)	0.65 (0.16)	0.89 (0.33)	0.58 (0.15)	0.46 (0.11)	0.41 (0.11)	0.65 (0.17)	0.77 (0.19)
$(La/Y)_{CN}$	1.17 (0.30)	1.25 (0.31)	1.39 (0.34)	1.88 (0.67)	1.15 (0.29)	0.84 (0.21)	0.65 (0.17)	1.25 (0.32)	1.49 (0.36)
$Eu_A = Eu/Eu^*$	0.32 (0.02)	0.33 (0.02)	0.41 (0.02)	0.42 (0.03)	0.40 (0.03)	0.28 (0.02)	0.29 (0.02)	0.38 (0.03)	0.40 (0.02)
$Ce_A = Ce/Ce^*$	1.08 (0.07)	1.07 (0.07)	1.10 (0.07)	1.13 (0.16)	1.13 (0.08)	1.13 (0.07)	1.10 (0.08)	1.15 (0.08)	1.16 (0.08)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_37	Sisson_S_38	Sisson_S_39	Sisson_S_40	Sisson_S_41	Sisson_S_42	Sisson_S_43	Sisson_S_44	Sisson_S_45
Li	≤ LOD	≤ LOD	≤ LOD	1 (0.2)	≤ LOD	≤ LOD	≤ LOD	3 (0.3)	4 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	3 (0.1)	3 (0.1)	4 (0.2)	4 (0.2)	4 (0.1)	4 (0.2)	4 (0.2)	4 (0.1)	4 (0.2)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	35.8 (1.0)	36.5 (1.1)	32.1 (1.2)	44.6 (1.6)	47.0 (1.7)	45.1 (1.7)	54.2 (1.6)	62.0 (2.1)	69.2 (2.1)
Fe	3 (4.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.0)	≤ LOD	≤ LOD	3 (0.8)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	5 (0.3)	5 (0.2)	7 (0.4)	7 (0.3)	7 (0.3)	7 (0.3)	7 (0.3)	6 (0.3)	7 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	142.1 (4.0)	146.6 (4.4)	149.1 (5.7)	138.1 (4.6)	144.2 (4.1)	139.3 (3.9)	147.2 (4.4)	140.7 (4.5)	140.3 (4.9)
Y	493.0 (13.0)	517.0 (15.0)	848.0 (29.0)	754.0 (24.0)	813.0 (22.0)	760.0 (21.0)	895.0 (27.0)	841.0 (27.0)	920.0 (29.0)
Mo	9700 (280.0)	8490 (280.0)	9200 (320.0)	9080 (310.0)	9320 (300.0)	9200 (270.0)	8230 (250.0)	8160 (270.0)	8010 (280.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	709000 (44000)	724000 (44000)	718000 (47000)	692000 (40000)	701000 (42000)	684000 (41000)	720000 (45000)	682000 (43000)	695000 (50000)
La	103.4 (2.80)	105.9 (3.50)	167.5 (6.00)	136.7 (4.60)	159.3 (4.80)	137.3 (3.70)	181.7 (5.30)	157.4 (5.20)	194.8 (6.30)
Ce	409.0 (11.00)	427.0 (13.00)	689.0 (24.00)	590.0 (20.00)	652.0 (20.00)	580.0 (16.00)	777.0 (23.00)	681.0 (22.00)	792.0 (25.00)
Pr	66.2 (1.80)	70.0 (2.20)	125.7 (4.50)	110.2 (3.70)	116.6 (3.50)	107.0 (3.30)	141.6 (4.20)	127.1 (4.50)	140.6 (4.60)
Nd	326.5 (9.20)	352.0 (12.00)	644.0 (24.00)	574.0 (19.00)	606.0 (18.00)	562.0 (18.00)	709.0 (20.00)	649.0 (22.00)	704.0 (22.00)
Sm	85.1 (2.30)	91.8 (2.80)	169.7 (6.50)	152.2 (5.20)	158.2 (4.80)	151.5 (4.40)	179.8 (5.20)	168.2 (6.20)	179.1 (5.60)
Eu	12.04 (0.34)	12.42 (0.43)	20.12 (0.73)	19.56 (0.64)	19.86 (0.58)	19.13 (0.62)	24.68 (0.74)	23.05 (0.71)	24.41 (0.85)
Gd	78.8 (2.30)	85.1 (2.90)	156.4 (6.00)	139.4 (4.70)	144.5 (3.80)	140.1 (4.30)	157.2 (5.10)	146.1 (4.80)	153.8 (4.90)
Tb	14.1 (0.45)	15.2 (0.47)	27.0 (0.95)	23.9 (0.79)	25.2 (0.74)	23.9 (0.69)	27.7 (0.80)	25.9 (0.89)	27.7 (0.86)
Dy	98.1 (2.80)	106.5 (3.30)	188.1 (7.20)	163.0 (5.20)	175.9 (5.10)	166.3 (5.10)	193.3 (5.50)	182.8 (5.70)	195.1 (6.10)
Ho	18.8 (0.49)	20.1 (0.62)	35.4 (1.20)	30.4 (1.00)	33.7 (0.99)	30.9 (0.98)	35.9 (0.99)	34.1 (1.10)	36.7 (1.10)
Er	55.9 (1.40)	58.8 (1.90)	104.3 (3.50)	89.5 (3.00)	99.5 (3.10)	91.1 (2.60)	107.5 (3.20)	102.8 (3.30)	110.8 (3.40)
Tm	7.8 (0.20)	8.2 (0.25)	14.4 (0.47)	11.9 (0.40)	13.7 (0.39)	12.5 (0.36)	15.0 (0.44)	14.4 (0.51)	15.8 (0.52)
Yb	46.0 (1.30)	47.6 (1.50)	80.7 (2.70)	66.5 (2.10)	80.0 (2.20)	71.5 (2.00)	88.5 (2.60)	85.1 (3.00)	94.6 (2.90)
Lu	5.3 (0.15)	5.5 (0.17)	9.3 (0.33)	7.5 (0.25)	9.1 (0.28)	8.2 (0.24)	10.2 (0.34)	10.0 (0.37)	11.2 (0.34)
$\sum$REE + Y	1820.0 (15.5)	1923.0 (19.1)	3279.6 (36.9)	2868.7 (29.8)	3106.6 (29.0)	2861.5 (26.1)	3544.0 (32.8)	3247.9 (33.6)	3600.7 (35.9)
$(La/Lu)_{CN}$	2.03 (0.48)	1.99 (0.50)	1.86 (0.50)	1.90 (0.49)	1.81 (0.45)	1.73 (0.41)	1.84 (0.46)	1.64 (0.43)	1.80 (0.45)
$(La/Sm)_{CN}$	0.76 (0.18)	0.72 (0.18)	0.62 (0.17)	0.56 (0.15)	0.63 (0.16)	0.57 (0.13)	0.63 (0.15)	0.59 (0.16)	0.68 (0.17)
$(La/Y)_{CN}$	1.39 (0.32)	1.36 (0.34)	1.31 (0.35)	1.21 (0.31)	1.30 (0.31)	1.20 (0.28)	1.35 (0.33)	1.24 (0.32)	1.41 (0.36)
$Eu_A = Eu/Eu^*$	0.44 (0.02)	0.42 (0.03)	0.37 (0.03)	0.40 (0.03)	0.39 (0.02)	0.39 (0.02)	0.44 (0.03)	0.44 (0.03)	0.44 (0.03)
$Ce_A = Ce/Ce^*$	1.15 (0.07)	1.14 (0.08)	1.08 (0.08)	1.08 (0.08)	1.09 (0.07)	1.08 (0.07)	1.09 (0.07)	1.08 (0.08)	1.09 (0.08)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_46	Sisson_S_47	Sisson_S_48	Sisson_S_49	Sisson_S_50	Sisson_S_51	Sisson_S_52	Sisson_S_53	Sisson_S_54
Li	2 (0.2)	≤ LOD	1 (0.2)	1 (0.2)	≤ LOD	2 (0.1)	2 (0.2)	≤ LOD	1 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	4 (0.1)	4 (0.2)	4 (0.1)	4 (0.1)	5 (0.2)	5 (0.2)	5 (0.2)	4 (0.2)	4 (0.1)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	56.2 (1.6)	39.4 (1.5)	59.7 (2.0)	50.5 (1.9)	45.2 (1.5)	46.7 (1.9)	66.3 (2.5)	76.1 (2.3)	74.6 (2.7)
Fe	≤ LOD	≤ LOD	3 (0.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	6 (0.3)	7 (0.4)	7 (0.3)	7 (0.4)	8 (0.3)	8 (0.5)	9 (0.4)	6 (0.3)	7 (0.4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	131.4 (4.0)	141.2 (4.5)	150.9 (5.1)	149.8 (4.9)	151.7 (5.4)	143.0 (4.7)	136.2 (4.9)	117.8 (3.9)	125.4 (4.3)
Y	823.0 (26.0)	907.0 (28.0)	870.0 (28.0)	914.0 (29.0)	962.0 (31.0)	943.0 (30.0)	1034.0 (35.0)	927.0 (26.0)	839.0 (26.0)
Mo	8080 (300.0)	8170 (260.0)	8360 (250.0)	7700 (260.0)	8570 (290.0)	7820 (260.0)	7660 (280.0)	7290 (210.0)	7820 (240.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	695000 (49000)	706000 (46000)	693000 (44000)	688000 (43000)	684000 (43000)	688000 (50000)	670000 (47000)	692000 (44000)	650000 (44000)
La	173.0 (5.20)	188.5 (5.50)	175.4 (5.60)	180.7 (5.90)	179.5 (6.10)	164.2 (5.90)	172.2 (5.80)	175.4 (5.20)	186.4 (6.40)
Ce	720.0 (19.00)	796.0 (24.00)	740.0 (22.00)	785.0 (27.00)	742.0 (26.00)	736.0 (28.00)	757.0 (28.00)	735.0 (22.00)	774.0 (27.00)
Pr	132.2 (4.00)	146.6 (5.00)	134.6 (4.40)	142.6 (5.10)	137.1 (4.40)	136.9 (4.70)	144.7 (5.50)	130.7 (4.00)	134.9 (4.70)
Nd	680.0 (21.00)	750.0 (27.00)	691.0 (22.00)	738.0 (26.00)	726.0 (24.00)	728.0 (25.00)	817.0 (29.00)	690.0 (21.00)	693.0 (26.00)
Sm	174.8 (5.40)	190.8 (6.30)	179.3 (5.60)	195.1 (6.50)	206.7 (7.00)	200.4 (7.70)	238.1 (8.10)	199.4 (6.40)	180.3 (6.80)
Eu	19.22 (0.63)	21.94 (0.72)	22.75 (0.69)	22.01 (0.72)	18.99 (0.62)	20.75 (0.75)	17.20 (0.63)	17.20 (0.54)	20.18 (0.77)
Gd	152.0 (4.30)	167.6 (5.70)	158.3 (4.90)	172.9 (5.40)	196.9 (6.30)	185.1 (6.50)	232.5 (8.70)	192.8 (6.20)	158.3 (5.60)
Tb	27.0 (0.86)	29.1 (0.92)	27.6 (0.88)	29.5 (1.00)	32.9 (1.10)	30.3 (1.00)	37.3 (1.40)	33.3 (1.00)	27.3 (0.90)
Dy	185.6 (5.90)	201.4 (7.00)	187.7 (6.00)	200.1 (6.40)	222.1 (7.40)	206.7 (7.00)	246.6 (9.50)	226.9 (6.90)	187.5 (6.60)
Ho	34.3 (1.10)	38.2 (1.30)	35.4 (1.10)	38.2 (1.30)	42.0 (1.40)	40.2 (1.40)	46.4 (1.60)	43.5 (1.30)	36.0 (1.20)
Er	101.1 (3.10)	112.8 (3.70)	102.8 (3.20)	109.9 (3.60)	117.8 (3.90)	115.4 (4.30)	127.3 (4.40)	119.9 (3.30)	103.4 (3.70)
Tm	14.1 (0.42)	15.9 (0.51)	14.2 (0.48)	15.3 (0.46)	15.8 (0.52)	15.8 (0.57)	16.6 (0.54)	16.1 (0.43)	15.0 (0.57)
Yb	83.2 (2.60)	93.4 (2.90)	81.8 (2.80)	85.4 (2.50)	87.1 (2.90)	89.4 (2.90)	90.6 (3.20)	92.2 (2.70)	88.0 (3.30)
Lu	9.5 (0.33)	10.8 (0.35)	9.4 (0.34)	9.9 (0.32)	9.9 (0.33)	10.3 (0.36)	10.6 (0.40)	10.8 (0.31)	10.6 (0.39)
∑REE + Y	3329.0 (30.8)	3670.0 (38.8)	3430.3 (33.6)	3638.6 (40.0)	3696.8 (38.5)	3622.5 (40.6)	3988.1 (44.2)	3610.2 (33.4)	3453.8 (40.2)
$(La/Lu)_{CN}$	1.88 (0.48)	1.82 (0.45)	1.92 (0.50)	1.89 (0.48)	1.87 (0.49)	1.65 (0.44)	1.69 (0.45)	1.68 (0.40)	1.82 (0.48)
$(La/Sm)_{CN}$	0.62 (0.15)	0.62 (0.15)	0.61 (0.15)	0.58 (0.15)	0.54 (0.14)	0.51 (0.14)	0.45 (0.12)	0.55 (0.14)	0.65 (0.17)
$(La/Y)_{CN}$	1.40 (0.35)	1.38 (0.34)	1.34 (0.34)	1.31 (0.33)	1.24 (0.32)	1.16 (0.30)	1.11 (0.29)	1.26 (0.30)	1.48 (0.38)
$Eu_A = Eu/Eu^*$	0.35 (0.02)	0.36 (0.02)	0.40 (0.02)	0.36 (0.02)	0.28 (0.02)	0.32 (0.02)	0.22 (0.01)	0.26 (0.02)	0.35 (0.02)
$Ce_A = Ce/Ce^*$	1.07 (0.07)	1.08 (0.08)	1.09 (0.07)	1.10 (0.08)	1.07 (0.08)	1.09 (0.08)	1.06 (0.08)	1.10 (0.07)	1.11 (0.08)

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TABLE C1. *(continued)*

Sample (ppm)	Sisson_S_55	Sisson_S_56	Sisson_S_57	Sisson_S_58	Sisson_S_59	Sisson_S_60	Sisson_S_61	Sisson_S_62
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.2)	1 (0.3)	2 (0.2)	2 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	3 (0.1)	4 (0.2)	5 (0.2)	5 (0.2)	5 (0.2)	5 (0.2)	4 (0.2)	4 (0.1)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	37.2 (1.2)	32.2 (1.2)	30.1 (1.0)	33.0 (1.5)	51.3 (1.7)	62.7 (2.2)	65.9 (2.5)	73.5 (2.1)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (2.8)	3 (5.4)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	6 (0.2)	7 (0.4)	9 (0.4)	9 (0.4)	8 (0.4)	8 (0.4)	7 (0.3)	7 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	118.1 (3.7)	146.3 (5.3)	143.7 (5.3)	140.3 (4.7)	137.6 (4.9)	142.6 (4.7)	146.2 (4.5)	131.6 (4.0)
Y	844.0 (24.0)	805.0 (27.0)	950.0 (36.0)	1090.0 (36.0)	888.0 (31.0)	980.0 (37.0)	848.0 (27.0)	806.0 (24.0)
Mo	7260 (210.0)	7940 (300.0)	8130 (290.0)	8400 (280.0)	8440 (310.0)	8230 (280.0)	8050 (270.0)	7870 (230.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	655000 (42000)	642000 (46000)	636000 (50000)	631000 (39000)	630000 (39000)	621000 (41000)	617000 (40000)	614000 (38000)
La	184.8 (5.40)	167.6 (5.80)	165.9 (6.10)	188.6 (7.20)	144.1 (4.40)	158.6 (4.70)	187.9 (6.30)	190.0 (5.70)
Ce	749.0 (21.00)	714.0 (26.00)	702.0 (26.00)	838.0 (30.00)	623.0 (19.00)	688.0 (23.00)	780.0 (28.00)	784.0 (25.00)
Pr	129.1 (3.80)	123.9 (3.80)	124.3 (4.30)	154.7 (5.10)	110.5 (3.20)	125.9 (4.10)	134.3 (4.60)	134.6 (4.50)
Nd	653.0 (19.00)	630.0 (22.00)	679.0 (25.00)	826.0 (28.00)	611.0 (21.00)	691.0 (22.00)	682.0 (24.00)	682.0 (22.00)
Sm	178.2 (5.40)	161.0 (5.20)	195.5 (7.30)	226.9 (7.80)	176.0 (6.10)	202.0 (6.90)	174.7 (5.80)	171.9 (5.50)
Eu	18.07 (0.57)	22.36 (0.71)	18.53 (0.75)	24.71 (0.90)	18.54 (0.63)	19.16 (0.62)	23.35 (0.84)	21.16 (0.72)
Gd	164.3 (4.80)	143.2 (4.70)	192.2 (7.50)	213.0 (7.20)	174.7 (5.90)	199.5 (6.20)	157.9 (5.40)	149.4 (4.50)
Tb	28.9 (0.85)	24.5 (0.86)	32.1 (1.20)	36.2 (1.10)	29.3 (1.00)	33.0 (1.10)	27.3 (0.94)	25.8 (0.80)
Dy	197.6 (5.90)	171.7 (5.70)	213.3 (8.00)	245.9 (7.90)	198.1 (6.80)	220.7 (7.60)	185.6 (6.60)	178.3 (5.50)
Ho	37.7 (1.10)	33.6 (1.20)	41.4 (1.60)	47.6 (1.60)	38.7 (1.40)	42.9 (1.50)	35.3 (1.20)	34.4 (1.10)
Er	107.4 (3.20)	97.7 (3.20)	112.9 (4.10)	133.0 (4.50)	106.5 (3.50)	115.9 (3.70)	101.4 (3.30)	99.4 (3.00)
Tm	15.1 (0.45)	14.1 (0.42)	15.4 (0.57)	18.2 (0.61)	14.5 (0.49)	15.6 (0.57)	14.6 (0.47)	14.5 (0.46)
Yb	88.4 (2.50)	82.7 (2.70)	86.8 (3.30)	100.9 (3.30)	80.4 (2.80)	85.7 (3.00)	85.3 (2.90)	85.7 (2.70)
Lu	10.7 (0.29)	10.0 (0.34)	10.1 (0.38)	11.9 (0.44)	9.4 (0.31)	9.8 (0.36)	10.1 (0.35)	10.2 (0.32)
∑REE + Y	3406.2 (30.8)	3201.4 (36.2)	3539.4 (39.5)	4155.6 (44.4)	3222.7 (31.2)	3587.8 (35.0)	3447.7 (39.4)	3387.4 (35.5)
$(La/Lu)_{CN}$	1.79 (0.43)	1.73 (0.45)	1.70 (0.46)	1.64 (0.45)	1.59 (0.40)	1.67 (0.43)	1.92 (0.50)	1.93 (0.48)
$(La/Sm)_{CN}$	0.65 (0.16)	0.65 (0.17)	0.53 (0.14)	0.52 (0.14)	0.51 (0.13)	0.49 (0.12)	0.67 (0.17)	0.69 (0.17)
$(La/Y)_{CN}$	1.46 (0.35)	1.38 (0.36)	1.16 (0.32)	1.15 (0.31)	1.08 (0.28)	1.08 (0.28)	1.47 (0.38)	1.57 (0.38)
$Eu_A = Eu/Eu^*$	0.32 (0.02)	0.44 (0.03)	0.29 (0.02)	0.34 (0.02)	0.32 (0.02)	0.29 (0.02)	0.42 (0.03)	0.39 (0.02)
$Ce_A = Ce/Ce^*$	1.11 (0.07)	1.12 (0.08)	1.11 (0.08)	1.09 (0.08)	1.11 (0.07)	1.09 (0.08)	1.12 (0.08)	1.12 (0.08)

TABLE C2. Moose River, NS, Canada (C1012).

Sample (ppm)	C1012_S_1	C1012_S_2	C1012_S_3	C1012_S_4	C1012_S_5	C1012_S_6	C1012_S_7	C1012_S_8	C1012_S_9
Li	≤ LOD	≤ LOD	1 (0.2)	≤ LOD	1 (0.2)	1 (0.2)	1 (0.2)	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	6.0 (0.3)	6.6 (0.3)	6.5 (0.3)	6.6 (0.3)	6.8 (0.3)	6.7 (0.2)	6.7 (0.3)	6.7 (0.3)	6.8 (0.3)
Fe	≤ LOD	7 (16.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	3 (0.2)	3 (0.2)	4 (0.3)	3 (0.2)	3 (0.2)	2 (0.2)	4 (0.2)	4 (0.2)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	960.0 (12.0)	1086.0 (13.0)	995.0 (15.0)	1040.0 (12.0)	1071.0 (14.0)	1002.0 (13.0)	1012.0 (10.0)	945.0 (11.0)	1058.0 (13.0)
Y	566.9 (7.3)	650.0 (7.7)	589.0 (11.0)	515.7 (5.5)	533.7 (6.0)	632.1 (7.2)	531.3 (7.3)	495.0 (16.0)	767.0 (66.0)
Mo	6 (0.2)	7 (0.2)	6 (0.3)	6 (0.2)	7 (0.2)	7 (0.2)	7 (0.3)	6 (0.2)	7 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	703300 (9700)	685400 (9300)	723400 (9300)	711200 (8400)	691800 (8000)	708000 (9100)	739600 (8500)	735000 (10000)	729000 (10000)
La	2.0 (0.05)	2.5 (0.04)	2.7 (0.06)	2.3 (0.04)	2.5 (0.04)	2.2 (0.05)	2.8 (0.05)	2.6 (0.06)	2.5 (0.07)
Ce	10.1 (0.16)	12.8 (0.17)	13.8 (0.19)	11.4 (0.15)	12.9 (0.17)	11.4 (0.18)	13.9 (0.20)	13.4 (0.20)	13.6 (0.47)
Pr	2.5 (0.04)	3.1 (0.05)	3.5 (0.07)	2.8 (0.04)	3.0 (0.06)	2.8 (0.05)	3.3 (0.06)	3.3 (0.08)	3.4 (0.16)
Nd	20.7 (0.34)	24.1 (0.34)	27.2 (0.42)	22.1 (0.32)	23.1 (0.35)	23.1 (0.40)	25.1 (0.47)	25.1 (0.48)	26.0 (1.30)
Sm	14.1 (0.21)	15.9 (0.29)	17.8 (0.36)	15.4 (0.30)	14.2 (0.29)	16.0 (0.27)	15.6 (0.34)	16.3 (0.34)	18.3 (1.10)
Eu	5.49 (0.09)	6.20 (0.09)	6.53 (0.11)	5.60 (0.10)	6.32 (0.09)	5.93 (0.10)	6.78 (0.14)	6.66 (0.15)	6.21 (0.15)
Gd	42.3 (0.59)	43.6 (0.60)	50.1 (0.75)	42.8 (0.54)	38.0 (0.53)	49.0 (0.72)	42.8 (0.64)	44.5 (0.80)	49.6 (2.60)
Tb	11.5 (0.13)	11.7 (0.15)	12.8 (0.19)	11.5 (0.15)	10.1 (0.11)	13.2 (0.17)	11.0 (0.13)	11.3 (0.22)	14.0 (0.99)
Dy	114.8 (1.60)	116.3 (1.40)	120.8 (1.90)	112.0 (1.20)	101.2 (1.20)	128.7 (1.60)	105.4 (1.20)	107.1 (2.10)	139.4 (9.70)
Ho	28.7 (0.34)	31.0 (0.34)	30.2 (0.42)	27.8 (0.27)	26.9 (0.30)	32.3 (0.36)	25.8 (0.29)	27.2 (0.49)	36.0 (2.40)
Er	80.1 (0.76)	90.8 (1.20)	83.5 (1.30)	75.8 (0.91)	77.8 (0.90)	88.5 (1.00)	72.3 (0.80)	75.2 (1.80)	106.1 (7.60)
Tm	8.7 (0.10)	10.1 (0.13)	9.0 (0.18)	7.9 (0.12)	8.2 (0.10)	9.4 (0.12)	7.8 (0.10)	7.7 (0.25)	12.0 (1.10)
Yb	34.7 (0.46)	40.6 (0.68)	36.3 (0.84)	30.0 (0.40)	31.0 (0.49)	37.8 (0.54)	31.7 (0.44)	28.8 (1.30)	54.1 (6.10)
Lu	2.6 (0.04)	3.2 (0.07)	2.8 (0.07)	2.2 (0.03)	2.5 (0.04)	2.8 (0.05)	2.4 (0.05)	2.3 (0.09)	3.8 (0.35)
∑REE + Y	945.2 (2.0)	1061.9 (2.2)	1005.9 (2.7)	885.2 (1.7)	891.4 (1.8)	1055.2 (2.2)	897.9 (1.8)	866.4 (3.3)	1251.9 (14.4)
$(La/Lu)_{CN}$	0.08 (0.02)	0.08 (0.02)	0.10 (0.02)	0.11 (0.02)	0.10 (0.02)	0.08 (0.02)	0.12 (0.02)	0.12 (0.03)	0.07 (0.02)
$(La/Sm)_{CN}$	0.09 (0.02)	0.10 (0.02)	0.09 (0.02)	0.09 (0.02)	0.11 (0.02)	0.09 (0.02)	0.11 (0.02)	0.10 (0.02)	0.09 (0.03)
$(La/Y)_{CN}$	0.02 (0.00)	0.03 (0.00)	0.03 (0.01)	0.03 (0.01)	0.03 (0.01)	0.02 (0.00)	0.03 (0.01)	0.04 (0.01)	0.02 (0.01)
$Eu_A = Eu/Eu^*$	0.63 (0.02)	0.67 (0.02)	0.62 (0.02)	0.62 (0.02)	0.78 (0.03)	0.59 (0.02)	0.75 (0.03)	0.71 (0.03)	0.59 (0.05)
$Ce_A = Ce/Ce^*$	0.90 (0.05)	0.93 (0.05)	0.91 (0.05)	0.92 (0.05)	0.96 (0.05)	0.93 (0.05)	0.95 (0.05)	0.92 (0.05)	0.93 (0.09)

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TABLE C2. *(continued)*

Sample (ppm)	C1012_S_10	C1012_T_1	C1012_T_2	C1012_T_3	C1012_T_4	C1012_T_5	C1012_T_6	C1012_T_7	C1012_T_8
Li	2 (0.2)	2 (0.2)	1 (0.1)	≤ LOD	≤ LOD	1 (0.1)	2 (0.1)	2 (0.1)	2 (0.1)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	70 (25.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	1 (0.3)	4 (0.3)	3 (0.3)	3 (0.3)	≤ LOD	≤ LOD
Mn	7.8 (0.3)	7.5 (0.2)	8.5 (0.3)	7.9 (0.2)	8.3 (0.1)	8.8 (0.3)	8.4 (0.2)	8.1 (0.2)	7.6 (0.2)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	4 (0.3)	3 (0.2)	4 (0.3)	5 (0.4)	4 (0.3)	4 (0.2)	3 (0.2)	4 (0.2)	4 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	986.0 (11.0)	931.0 (10.0)	991.0 (14.0)	1011.0 (12.0)	957.0 (10.0)	1020.0 (10.0)	1055.0 (11.0)	1078.1 (9.0)	1063.4 (8.5)
Y	615.5 (9.9)	417.0 (18.0)	520.0 (11.0)	585.1 (9.4)	574.8 (6.2)	573.5 (7.4)	629.0 (10.0)	582.7 (7.1)	614.0 (11.0)
Mo	7 (0.2)	6 (0.2)	6 (0.2)	6 (0.2)	6 (0.1)	7 (0.1)	7 (0.1)	7 (0.1)	7 (0.1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	758200 (7600)	694300 (7500)	700600 (6500)	706100 (6700)	701500 (5500)	713700 (5600)	708300 (5200)	716800 (5100)	720600 (5100)
La	2.6 (0.05)	3.0 (0.12)	2.8 (0.04)	2.8 (0.04)	2.4 (0.03)	2.4 (0.03)	2.6 (0.03)	2.6 (0.03)	2.5 (0.03)
Ce	13.7 (0.19)	16.0 (0.48)	14.7 (0.20)	14.6 (0.18)	12.8 (0.13)	12.8 (0.14)	13.5 (0.14)	13.4 (0.13)	13.2 (0.12)
Pr	3.4 (0.06)	4.0 (0.11)	3.6 (0.06)	3.5 (0.05)	3.1 (0.04)	3.1 (0.04)	3.2 (0.04)	3.2 (0.03)	3.2 (0.04)
Nd	27.0 (0.52)	33.6 (0.69)	29.7 (0.45)	27.8 (0.41)	25.6 (0.30)	24.6 (0.29)	25.3 (0.33)	25.3 (0.34)	25.7 (0.33)
Sm	17.5 (0.42)	23.1 (0.53)	19.4 (0.38)	18.0 (0.28)	17.0 (0.22)	16.5 (0.22)	16.7 (0.26)	16.5 (0.24)	16.9 (0.26)
Eu	7.26 (0.11)	8.36 (0.19)	7.34 (0.11)	7.11 (0.10)	6.42 (0.07)	6.24 (0.08)	6.66 (0.08)	6.64 (0.08)	6.72 (0.09)
Gd	49.5 (0.78)	59.1 (1.60)	51.5 (0.92)	48.5 (0.64)	47.3 (0.50)	44.7 (0.50)	46.0 (0.74)	45.8 (0.63)	46.6 (0.69)
Tb	12.6 (0.17)	13.5 (0.39)	12.7 (0.25)	12.7 (0.15)	12.3 (0.13)	11.9 (0.14)	12.2 (0.19)	12.0 (0.15)	12.3 (0.18)
Dy	121.4 (1.80)	114.1 (3.50)	116.6 (2.40)	122.7 (1.60)	122.2 (1.30)	118.9 (1.30)	124.2 (1.90)	121.2 (1.40)	124.9 (2.00)
Ho	29.4 (0.39)	24.3 (0.79)	27.9 (0.50)	30.4 (0.40)	30.2 (0.31)	29.5 (0.32)	31.6 (0.46)	30.5 (0.35)	31.3 (0.48)
Er	82.6 (1.10)	59.8 (2.30)	73.5 (1.40)	85.5 (1.20)	82.3 (0.82)	82.0 (0.91)	89.3 (1.30)	84.9 (1.00)	88.8 (1.50)
Tm	9.3 (0.14)	5.8 (0.25)	7.8 (0.18)	9.1 (0.16)	8.8 (0.09)	8.8 (0.13)	9.8 (0.16)	9.1 (0.12)	9.5 (0.18)
Yb	37.8 (0.69)	22.4 (1.20)	29.4 (0.82)	36.1 (0.72)	35.2 (0.46)	35.3 (0.58)	38.9 (0.76)	35.3 (0.59)	38.2 (0.90)
Lu	2.7 (0.07)	1.6 (0.09)	2.1 (0.06)	2.7 (0.05)	2.6 (0.03)	2.6 (0.04)	2.8 (0.05)	2.6 (0.04)	2.8 (0.07)
∑REE + Y	1032.3 (2.5)	805.7 (4.8)	918.9 (3.2)	1006.4 (2.3)	983.1 (1.8)	972.6 (1.8)	1051.6 (2.6)	991.6 (2.0)	1036.6 (2.8)
$(La/Lu)_{CN}$	0.10 (0.02)	0.19 (0.06)	0.14 (0.03)	0.11 (0.02)	0.10 (0.02)	0.10 (0.02)	0.10 (0.02)	0.10 (0.02)	0.10 (0.02)
$(La/Sm)_{CN}$	0.09 (0.02)	0.08 (0.02)	0.09 (0.02)	0.10 (0.02)	0.09 (0.01)	0.09 (0.01)	0.10 (0.02)	0.10 (0.02)	0.09 (0.02)
$(La/Y)_{CN}$	0.03 (0.01)	0.05 (0.01)	0.04 (0.01)	0.03 (0.01)	0.03 (0.00)	0.03 (0.00)	0.03 (0.00)	0.03 (0.00)	0.03 (0.00)
$Eu_A = Eu/Eu^*$	0.70 (0.03)	0.65 (0.03)	0.67 (0.03)	0.69 (0.02)	0.64 (0.02)	0.66 (0.02)	0.69 (0.03)	0.69 (0.02)	0.68 (0.03)
$Ce_A = Ce/Ce^*$	0.93 (0.05)	0.92 (0.06)	0.93 (0.05)	0.95 (0.05)	0.94 (0.04)	0.94 (0.04)	0.95 (0.05)	0.96 (0.04)	0.93 (0.04)

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TABLE C2. *(continued)*

Sample (ppm)	C1012_T_9
Li	1 (0.1)
B	≤ LOD
Na	≤ LOD
K	≤ LOD
Ti	≤ LOD
V	≤ LOD
Cr	≤ LOD
Mn	7.1 (0.2)
Fe	≤ LOD
Co	≤ LOD
Ni	≤ LOD
Cu	2 (0.4)
Zn	≤ LOD
As	4 (0.2)
Rb	≤ LOD
Sr	1012.0 (10.0)
Y	594.0 (14.0)
Mo	7 (0.2)
Ag	≤ LOD
Sn	≤ LOD
Ba	≤ LOD
W	723700 (5900)
La	2.3 (0.04)
Ce	12.2 (0.17)
Pr	3.0 (0.04)
Nd	24.4 (0.38)
Sm	16.7 (0.38)
Eu	6.35 (0.16)
Gd	47.3 (1.30)
Tb	12.5 (0.33)
Dy	126.6 (3.00)
Ho	31.5 (0.75)
Er	86.7 (2.10)
Tm	9.4 (0.29)
Yb	37.0 (1.50)
Lu	2.7 (0.10)
∑REE + Y	1012.7 (4.3)
$(La/Lu)_{CN}$	0.09 (0.02)
$(La/Sm)_{CN}$	0.09 (0.02)
$(La/Y)_{CN}$	0.03 (0.01)
Eu_A = Eu/Eu*	0.64 (0.03)
Ce_A = Ce/Ce*	0.94 (0.05)

TABLE C3. Little Long Lac, ON, Canada (C1661).

Sample (ppm)	C1661_S_1	C1661_S_2	C1661_S_3	C1661_S_4	C1661_S_5	C1661_S_6
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1 (0.2)	≤ LOD	≤ LOD	≤ LOD	3 (0.2)	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	6720.0 (190.0)	9050.0 (300.0)	6410.0 (210.0)	9300.0 (240.0)	11430.0 (320.0)	7170.0 (190.0)
Y	3.4 (0.1)	2.3 (0.2)	2.6 (0.1)	2.0 (0.1)	7.7 (0.2)	0.8 (0.0)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	2 (0.1)	≤ LOD	≤ LOD	≤ LOD	2 (0.2)	≤ LOD
W	806000 (50000)	788000 (52000)	790000 (50000)	789000 (50000)	790000 (53000)	791000 (47000)
La	0.7 (0.02)	0.7 (0.04)	0.7 (0.04)	0.6 (0.02)	3.9 (0.12)	0.2 (0.01)
Ce	1.4 (0.05)	1.3 (0.08)	1.3 (0.07)	1.2 (0.04)	7.5 (0.20)	0.3 (0.02)
Pr	0.2 (0.01)	0.2 (0.01)	0.2 (0.01)	0.1 (0.01)	0.9 (0.03)	≤ LOD
Nd	1.1 (0.06)	0.7 (0.06)	0.8 (0.05)	0.6 (0.04)	3.6 (0.13)	≤ LOD
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.9 (0.06)	≤ LOD
Eu	0.57 (0.03)	0.39 (0.03)	0.46 (0.03)	0.31 (0.02)	1.61 (0.05)	0.10 (0.01)
Gd	0.5 (0.04)	0.3 (0.04)	0.4 (0.04)	0.2 (0.02)	1.0 (0.07)	≤ LOD
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.5 (0.03)	≤ LOD	0.4 (0.03)	≤ LOD	1.1 (0.05)	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.02)	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.3 (0.03)	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	9.4 (0.1)	6.8 (0.1)	7.6 (0.1)	5.8 (0.1)	29.4 (0.3)	1.9 (0.0)
$(La/Lu)_{CN}$	4.71 (2.00)	5.56 (2.88)	5.06 (2.51)	6.27 (3.00)	13.94 (6.02)	5.22 (3.15)
$(La/Sm)_{CN}$	1.14 (0.42)	1.91 (0.83)	1.48 (0.59)	2.56 (1.05)	2.81 (0.89)	3.02 (1.79)
$(La/Y)_{CN}$	1.43 (0.37)	1.94 (0.67)	1.74 (0.55)	2.10 (0.57)	3.36 (0.82)	1.78 (0.59)
Eu_A = Eu/Eu*	3.70 (0.50)	4.59 (0.97)	3.96 (0.59)	5.21 (0.96)	5.20 (0.55)	5.74 (2.16)
Ce_A = Ce/Ce*	0.86 (0.06)	0.92 (0.10)	0.88 (0.10)	0.92 (0.08)	0.94 (0.06)	0.85 (0.11)

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TABLE C3. *(continued)*

Sample (ppm)	C1661_S_7	C1661_S_8	C1661_S_9	C1661_S_10	C1661_S_11	C1661_S_12	C1661_S_13	C1661_S_14	C1661_S_15
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.9 (0.2)	≤ LOD	≤ LOD	≤ LOD	2.1 (0.2)	≤ LOD	1.5 (0.2)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1 (0.3)	≤ LOD	3 (0.3)	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	7840.0 (220.0)	11480.0 (330.0)	6230.0 (190.0)	8050.0 (230.0)	7910.0 (210.0)	7770.0 (200.0)	6640.0 (220.0)	7240.0 (220.0)	5160.0 (170.0)
Y	1.0 (0.1)	2.5 (0.1)	2.1 (0.1)	0.6 (0.0)	1.7 (0.1)	4.4 (0.1)	7.2 (0.3)	1.9 (0.1)	4.0 (0.2)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	7 (0.4)	≤ LOD	≤ LOD	≤ LOD	2 (0.2)	1 (0.1)	≤ LOD	1 (0.2)	3 (0.2)
W	738000 (48000)	706000 (47000)	705000 (44000)	755000 (47000)	710000 (42000)	729000 (48000)	743000 (49000)	784000 (49000)	810000 (47000)
La	0.2 (0.02)	0.9 (0.04)	0.6 (0.03)	0.3 (0.02)	0.4 (0.02)	1.1 (0.04)	1.7 (0.07)	0.5 (0.03)	1.1 (0.04)
Ce	0.5 (0.03)	1.5 (0.05)	1.1 (0.04)	0.4 (0.03)	0.8 (0.04)	1.9 (0.07)	3.4 (0.12)	1.0 (0.04)	2.3 (0.08)
Pr	≤ LOD	0.2 (0.01)	0.1 (0.01)	≤ LOD	≤ LOD	0.2 (0.01)	0.5 (0.03)	≤ LOD	0.3 (0.02)
Nd	≤ LOD	0.6 (0.04)	0.7 (0.04)	≤ LOD	≤ LOD	0.9 (0.05)	2.4 (0.12)	0.5 (0.03)	1.8 (0.08)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.9 (0.07)	≤ LOD	0.6 (0.05)
Eu	0.13 (0.01)	0.29 (0.02)	0.31 (0.02)	≤ LOD	0.24 (0.02)	0.53 (0.02)	1.31 (0.05)	0.28 (0.02)	0.80 (0.04)
Gd	≤ LOD	0.2 (0.03)	0.3 (0.02)	≤ LOD	≤ LOD	0.4 (0.03)	1.3 (0.06)	0.2 (0.03)	0.8 (0.06)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.2 (0.01)	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.04)	1.1 (0.06)	≤ LOD	0.7 (0.04)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.02)	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	2.7 (0.1)	7.0 (0.1)	6.1 (0.1)	1.9 (0.1)	4.2 (0.1)	10.7 (0.1)	21.0 (0.2)	5.3 (0.1)	13.2 (0.2)
$(La/Lu)_{CN}$	3.58 (2.08)	4.87 (2.09)	4.26 (2.03)	5.63 (3.27)	5.29 (2.88)	4.34 (1.75)	4.99 (1.96)	5.65 (3.09)	5.58 (2.56)
$(La/Sm)_{CN}$	2.14 (1.16)	2.93 (1.18)	2.01 (0.86)	3.99 (2.47)	3.40 (1.82)	2.21 (0.81)	1.12 (0.40)	1.98 (0.89)	1.17 (0.40)
$(La/Y)_{CN}$	1.66 (0.63)	2.35 (0.64)	1.85 (0.53)	2.76 (1.00)	1.65 (0.52)	1.61 (0.42)	1.54 (0.43)	1.87 (0.56)	1.89 (0.52)
$Eu_A = Eu/Eu^*$	4.16 (1.28)	4.35 (0.78)	4.16 (0.68)	2.83 (1.13)	6.91 (1.89)	4.68 (0.64)	3.65 (0.37)	4.25 (0.91)	3.53 (0.44)
$Ce_A = Ce/Ce^*$	0.97 (0.14)	0.90 (0.08)	0.92 (0.08)	0.87 (0.12)	0.89 (0.09)	0.89 (0.07)	0.90 (0.07)	0.89 (0.09)	0.88 (0.07)

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TABLE C3. *(continued)*

Sample (ppm)	C1661_S_16	C1661_S_17	C1661_S_18	C1661_S_19
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	2 (0.9)	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	6820.0 (210.0)	7800.0 (240.0)	7310.0 (250.0)	7940.0 (210.0)
Y	2.0 (0.1)	2.0 (0.1)	3.0 (0.1)	2.8 (0.1)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	3 (0.2)	3 (0.2)	4 (0.2)	2 (0.1)
W	823000 (48000)	817000 (50000)	834000 (49000)	846000 (55000)
La	0.7 (0.03)	0.9 (0.04)	1.1 (0.05)	0.7 (0.03)
Ce	1.2 (0.04)	1.3 (0.05)	1.9 (0.08)	1.4 (0.05)
Pr	0.1 (0.01)	0.1 (0.01)	0.2 (0.01)	0.2 (0.01)
Nd	≤ LOD	0.5 (0.04)	0.8 (0.06)	1.0 (0.06)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	0.29 (0.02)	0.23 (0.02)	0.37 (0.02)	0.53 (0.03)
Gd	0.2 (0.03)	≤ LOD	0.3 (0.02)	0.4 (0.04)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	0.4 (0.03)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	5.8 (0.1)	5.9 (0.1)	8.6 (0.1)	8.2 (0.1)
$(La/Lu)_{CN}$	5.23 (2.45)	7.20 (3.59)	6.21 (2.76)	5.45 (2.72)
$(La/Sm)_{CN}$	2.75 (1.13)	3.83 (1.69)	3.61 (1.49)	1.25 (0.45)
$(La/Y)_{CN}$	2.44 (0.65)	2.87 (0.84)	2.52 (0.72)	1.58 (0.42)
Eu_A = Eu/Eu*	4.53 (0.84)	4.58 (1.02)	4.86 (0.77)	4.26 (0.59)
Ce_A = Ce/Ce*	0.86 (0.07)	0.84 (0.07)	0.91 (0.08)	0.90 (0.07)

TABLE C4. Delnite, ON, Canada (C1675).

Sample (ppm)	C1675_S_6	C1675_S_7
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	≤ LOD	2.4 (0.4)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD
Sr	198.8 (3.7)	371.0 (13.0)
Y	0.6 (0.0)	6.6 (0.9)
Mo	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	7 (0.5)
W	738200 (9400)	737500 (8500)
La	≤ LOD	2.4 (0.20)
Ce	0.3 (0.02)	4.9 (0.49)
Pr	≤ LOD	0.6 (0.07)
Nd	≤ LOD	2.6 (0.34)
Sm	≤ LOD	0.7 (0.13)
Eu	0.73 (0.03)	1.90 (0.11)
Gd	≤ LOD	0.7 (0.12)
Tb	≤ LOD	≤ LOD
Dy	≤ LOD	1.0 (0.15)
Ho	≤ LOD	≤ LOD
Er	≤ LOD	0.7 (0.12)
Tm	≤ LOD	≤ LOD
Yb	≤ LOD	0.9 (0.13)
Lu	≤ LOD	≤ LOD
∑REE + Y	2.1 (0.1)	23.7 (0.7)
$(La/Lu)_{CN}$	3.33 (2.05)	1.72 (0.86)
$(La/Sm)_{CN}$	2.77 (1.83)	2.15 (1.11)
$(La/Y)_{CN}$	2.14 (0.82)	2.45 (1.16)
Eu_A = Eu/Eu*	63.62 (34.49)	7.90 (2.04)
Ce_A = Ce/Ce*	0.77 (0.14)	0.93 (0.16)

TABLE C5. Hollinger, ON, Canada (C1759).

Sample (ppm)	C1759_S_1	C1759_S_2	C1759_S_3	C1759_S_4	C1759_S_5	C1759_S_6	C1759_S_7	C1759_S_8	C1759_S_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	34 (7.0)	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.5 (0.3)	1.4 (0.3)	≤ LOD	1.6 (0.3)	1.2 (0.2)	2.1 (0.2)	≤ LOD	3.1 (0.3)	1.3 (0.2)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (2.2)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	42 (3.5)	28 (2.2)	≤ LOD	5 (0.5)	5 (0.3)	4 (0.3)	2 (0.2)	160 (8.9)	9 (0.5)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	595.0 (12.0)	616.0 (12.0)	361.0 (5.6)	451.1 (6.5)	424.3 (6.4)	390.3 (6.6)	448.9 (6.7)	1155.0 (23.0)	369.9 (5.0)
Y	81.1 (1.5)	29.2 (0.4)	6.3 (0.2)	76.5 (1.9)	21.9 (0.6)	9.4 (0.2)	109.1 (2.2)	107.9 (1.9)	11.7 (0.3)
Mo	6 (0.3)	7 (0.3)	5 (0.2)	12 (0.3)	4 (0.1)	5 (0.2)	10 (0.3)	10 (0.3)	5 (0.3)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (0.7)	≤ LOD
W	738000 (14000)	747000 (12000)	744000 (11000)	763000 (11000)	706400 (9900)	690000 (11000)	697000 (11000)	743000 (11000)	742000 (10000)
La	8.7 (0.12)	14.6 (0.27)	4.3 (0.10)	18.8 (0.22)	10.1 (0.16)	5.4 (0.08)	15.1 (0.90)	26.6 (0.45)	4.1 (0.07)
Ce	33.4 (0.64)	19.7 (0.51)	9.0 (0.13)	44.0 (0.73)	36.4 (0.57)	11.5 (0.21)	61.4 (3.40)	70.7 (1.10)	11.0 (0.17)
Pr	8.6 (0.15)	2.0 (0.08)	1.3 (0.04)	6.6 (0.17)	7.3 (0.12)	1.6 (0.03)	12.7 (0.73)	11.0 (0.21)	2.0 (0.05)
Nd	58.8 (1.60)	7.5 (0.32)	4.9 (0.18)	30.7 (1.10)	42.3 (0.63)	6.7 (0.14)	76.0 (3.50)	53.2 (0.93)	11.9 (0.28)
Sm	21.2 (0.61)	1.7 (0.09)	1.0 (0.08)	7.5 (0.32)	11.5 (0.24)	1.5 (0.07)	22.8 (0.88)	14.8 (0.43)	3.7 (0.14)
Eu	36.74 (0.94)	42.82 (0.64)	40.19 (0.87)	36.23 (0.51)	46.87 (0.75)	43.10 (0.84)	40.85 (0.83)	61.40 (1.10)	42.91 (0.71)
Gd	23.2 (0.69)	1.6 (0.10)	0.9 (0.07)	8.2 (0.37)	9.0 (0.21)	1.3 (0.06)	23.9 (0.68)	15.2 (0.39)	3.7 (0.15)
Tb	3.3 (0.07)	0.3 (0.02)	≤ LOD	1.3 (0.06)	1.2 (0.03)	0.2 (0.01)	3.6 (0.10)	2.4 (0.06)	0.5 (0.02)
Dy	19.5 (0.37)	1.9 (0.08)	0.9 (0.05)	9.5 (0.31)	6.5 (0.14)	1.2 (0.06)	23.2 (0.53)	15.9 (0.36)	2.8 (0.10)
Ho	3.3 (0.06)	0.4 (0.01)	≤ LOD	2.0 (0.09)	0.9 (0.03)	≤ LOD	4.2 (0.09)	3.0 (0.06)	0.5 (0.02)
Er	7.6 (0.13)	1.6 (0.05)	0.5 (0.03)	6.5 (0.21)	2.0 (0.07)	0.6 (0.03)	10.7 (0.22)	8.7 (0.19)	1.0 (0.05)
Tm	0.8 (0.02)	0.4 (0.02)	≤ LOD	1.0 (0.03)	≤ LOD	≤ LOD	1.2 (0.03)	1.3 (0.03)	≤ LOD
Yb	3.9 (0.11)	4.5 (0.13)	0.3 (0.03)	8.0 (0.20)	1.0 (0.05)	0.6 (0.04)	6.0 (0.16)	9.5 (0.20)	0.6 (0.04)
Lu	≤ LOD	0.7 (0.02)	≤ LOD	1.2 (0.03)	≤ LOD	≤ LOD	0.7 (0.02)	1.3 (0.03)	≤ LOD
∑REE + Y	310.5 (2.2)	129.0 (0.9)	70.0 (0.9)	257.9 (1.6)	197.2 (1.2)	83.3 (0.9)	411.3 (5.2)	403.0 (2.0)	96.6 (0.8)
$(La/Lu)_{CN}$	2.27 (0.54)	2.07 (0.45)	9.61 (3.29)	1.59 (0.31)	10.05 (3.00)	9.12 (2.82)	2.37 (0.70)	2.19 (0.45)	7.27 (2.38)
$(La/Sm)_{CN}$	0.26 (0.05)	5.42 (1.45)	2.61 (0.83)	1.57 (0.37)	0.55 (0.11)	2.31 (0.57)	0.42 (0.13)	1.12 (0.24)	0.70 (0.16)
$(La/Y)_{CN}$	0.71 (0.13)	3.33 (0.61)	4.48 (1.03)	1.63 (0.31)	3.06 (0.64)	3.81 (0.69)	0.92 (0.26)	1.64 (0.30)	2.33 (0.46)
$Eu_A = Eu/Eu^*$	5.01 (0.27)	77.09 (6.58)	124.45 (14.34)	14.01 (0.96)	13.51 (0.59)	93.88 (6.86)	5.29 (0.31)	12.31 (0.62)	35.03 (2.22)
$Ce_A = Ce/Ce^*$	0.83 (0.04)	0.77 (0.04)	0.92 (0.05)	0.95 (0.05)	0.97 (0.05)	0.93 (0.04)	0.98 (0.11)	0.99 (0.05)	0.91 (0.05)

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TABLE C5. *(continued)*

Sample (ppm)	C1759_S_10	C1759_S_11	C1759_S_12	C1759_S_13	C1759_S_14	C1759_S_15	C1759_S_16	C1759_S_17	C1759_S_18
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.1 (0.3)	≤ LOD	3.1 (0.4)	≤ LOD	2.5 (0.3)	3.0 (0.2)	1.3 (0.2)	2.5 (0.3)	1.3 (0.2)
Fe	≤ LOD	≤ LOD	5 (9.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	23 (1.5)	≤ LOD	45 (4.7)	≤ LOD	18 (1.8)	48 (1.5)	≤ LOD	17 (1.4)	5 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	510.0 (10.0)	366.2 (8.2)	653.0 (30.0)	371.2 (5.7)	546.0 (11.0)	652.0 (14.0)	393.3 (7.1)	481.2 (9.1)	395.3 (4.9)
Y	31.3 (0.6)	14.2 (0.3)	23.2 (1.3)	16.6 (0.4)	10.8 (0.2)	47.0 (1.8)	13.1 (0.3)	14.2 (0.3)	25.1 (0.5)
Mo	7 (0.2)	5 (0.2)	8 (0.3)	4 (0.2)	6 (0.2)	8 (0.3)	5 (0.3)	7 (0.3)	5 (0.1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1 (0.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	737000 (12000)	751000 (13000)	740000 (14000)	746000 (13000)	736000 (11000)	741000 (13000)	724000 (11000)	727000 (11000)	744000 (11000)
La	14.6 (0.26)	8.5 (0.20)	11.3 (0.49)	9.3 (0.16)	8.0 (0.32)	12.0 (0.22)	5.5 (0.07)	8.7 (0.16)	6.4 (0.09)
Ce	44.9 (0.75)	10.3 (0.26)	27.8 (1.50)	27.7 (0.49)	15.9 (0.52)	37.8 (0.99)	14.3 (0.22)	18.6 (0.30)	20.1 (0.32)
Pr	7.8 (0.14)	0.9 (0.03)	4.1 (0.25)	4.9 (0.10)	2.0 (0.06)	7.1 (0.23)	2.2 (0.05)	2.5 (0.06)	3.6 (0.08)
Nd	40.0 (0.79)	2.6 (0.10)	18.7 (1.30)	25.4 (0.48)	8.7 (0.28)	41.1 (1.60)	9.8 (0.24)	11.0 (0.25)	20.2 (0.45)
Sm	9.7 (0.23)	0.5 (0.04)	4.7 (0.33)	6.4 (0.22)	2.1 (0.09)	12.4 (0.53)	2.3 (0.11)	2.5 (0.12)	6.2 (0.21)
Eu	44.48 (0.67)	60.90 (1.60)	36.99 (0.85)	46.26 (0.93)	32.42 (0.60)	35.69 (0.90)	38.91 (0.62)	33.78 (0.56)	64.94 (0.87)
Gd	8.7 (0.21)	0.3 (0.03)	4.4 (0.30)	5.0 (0.14)	1.8 (0.10)	11.5 (0.69)	1.9 (0.08)	2.2 (0.08)	6.1 (0.24)
Tb	1.1 (0.03)	≤ LOD	0.6 (0.04)	0.7 (0.02)	0.3 (0.01)	1.7 (0.09)	0.3 (0.01)	0.3 (0.01)	0.9 (0.03)
Dy	6.5 (0.16)	0.5 (0.04)	4.0 (0.29)	3.9 (0.13)	1.7 (0.07)	9.9 (0.49)	1.8 (0.06)	2.0 (0.07)	5.2 (0.15)
Ho	1.0 (0.03)	≤ LOD	0.7 (0.05)	0.6 (0.02)	0.3 (0.01)	1.6 (0.08)	0.3 (0.01)	0.4 (0.02)	0.9 (0.03)
Er	2.4 (0.08)	0.5 (0.03)	1.9 (0.12)	1.4 (0.07)	0.8 (0.03)	3.9 (0.18)	0.9 (0.04)	1.0 (0.04)	2.1 (0.06)
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.03)	≤ LOD	≤ LOD	≤ LOD
Yb	1.5 (0.08)	1.7 (0.07)	1.7 (0.11)	0.9 (0.05)	0.7 (0.05)	3.0 (0.11)	0.8 (0.04)	1.0 (0.05)	1.2 (0.05)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	214.4 (1.4)	101.3 (1.6)	140.4 (2.3)	149.3 (1.2)	85.9 (0.9)	225.5 (2.3)	92.3 (0.7)	98.4 (0.7)	163.2 (1.1)
$(La/Lu)_{CN}$	9.53 (2.42)	3.43 (0.91)	5.73 (1.92)	10.89 (3.32)	9.35 (3.31)	3.73 (0.96)	6.49 (1.82)	8.05 (2.34)	5.40 (1.55)
$(La/Sm)_{CN}$	0.94 (0.19)	11.49 (3.93)	1.51 (0.51)	0.91 (0.21)	2.40 (0.69)	0.61 (0.15)	1.54 (0.38)	2.17 (0.56)	0.65 (0.14)
$(La/Y)_{CN}$	3.10 (0.59)	3.95 (0.84)	3.23 (1.02)	3.73 (0.77)	4.94 (1.22)	1.70 (0.40)	2.82 (0.51)	4.09 (0.81)	1.70 (0.31)
$Eu_A = Eu/Eu^*$	14.44 (0.65)	489.74 (77.04)	24.47 (2.60)	23.84 (1.37)	49.09 (3.64)	8.95 (0.71)	55.21 (4.05)	42.57 (3.03)	31.67 (1.85)
$Ce_A = Ce/Ce^*$	0.99 (0.05)	0.73 (0.04)	0.98 (0.10)	0.98 (0.05)	0.92 (0.07)	0.95 (0.06)	0.99 (0.05)	0.94 (0.05)	0.98 (0.05)

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TABLE C5. *(continued)*

Sample (ppm)	C1759_S_19	C1759_S_20
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	1.8 (0.2)	1.1 (0.2)
Fe	≤ LOD	7 (15.0)
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	18 (1.8)	≤ LOD
Rb	≤ LOD	≤ LOD
Sr	535.0 (16.0)	431.2 (8.0)
Y	25.4 (1.8)	24.2 (0.6)
Mo	8 (0.8)	6 (0.2)
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	756000 (11000)	760000 (11000)
La	10.1 (0.25)	8.3 (0.17)
Ce	20.8 (0.95)	24.5 (0.46)
Pr	2.9 (0.20)	4.0 (0.07)
Nd	13.9 (1.20)	21.2 (0.43)
Sm	4.1 (0.45)	5.7 (0.21)
Eu	19.70 (1.00)	33.74 (0.90)
Gd	3.9 (0.40)	5.3 (0.18)
Tb	0.6 (0.07)	0.7 (0.02)
Dy	3.9 (0.39)	4.5 (0.15)
Ho	0.7 (0.07)	0.8 (0.03)
Er	2.0 (0.15)	1.9 (0.07)
Tm	0.3 (0.02)	≤ LOD
Yb	2.2 (0.11)	1.3 (0.05)
Lu	≤ LOD	≤ LOD
∑REE + Y	110.7 (2.0)	136.6 (1.2)
$(La/Lu)_{CN}$	3.39 (0.87)	6.17 (1.87)
$(La/Sm)_{CN}$	1.56 (0.57)	0.91 (0.22)
$(La/Y)_{CN}$	2.65 (0.82)	2.29 (0.48)
Eu_A = Eu/Eu*	14.87 (2.46)	18.30 (1.16)
Ce_A = Ce/Ce*	0.91 (0.08)	1.00 (0.05)

TABLE C6. Rocher Déboulé, BC, Canada (C1820).

Sample (ppm)	C1820_S_2	C1820_S_3	C1820_S_4	C1820_S_5	C1820_S_6
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.7 (0.3)	1.2 (0.2)	1.8 (0.3)	5.9 (1.1)	0.9 (0.3)
Fe	≤ LOD	≤ LOD	4 (18.0)	419 (89.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	2 (2.3)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	6 (6.1)	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	9 (5.9)	6 (0.4)	8 (3.2)	3 (0.2)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	97.6 (1.6)	103.0 (1.5)	125.1 (3.8)	111.2 (1.4)	107.5 (2.0)
Y	176.3 (2.1)	174.6 (2.6)	110.5 (1.2)	44.4 (1.0)	96.9 (1.3)
Mo	726 (11.0)	579 (9.4)	833 (11.0)	575 (11.0)	543 (8.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	736000 (11000)	737000 (13000)	727000 (10000)	740000 (12000)	740000 (10000)
La	62.7 (0.79)	74.9 (1.70)	52.2 (0.59)	42.9 (0.73)	38.9 (0.54)
Ce	176.1 (2.30)	209.0 (4.40)	152.9 (1.80)	121.8 (2.90)	110.7 (1.30)
Pr	26.8 (0.36)	30.9 (0.56)	23.7 (0.24)	17.0 (0.35)	17.5 (0.26)
Nd	146.1 (1.90)	163.1 (2.50)	131.0 (1.50)	84.2 (1.60)	98.1 (1.30)
Sm	42.4 (0.64)	43.0 (0.73)	34.1 (0.50)	17.7 (0.44)	27.4 (0.38)
Eu	5.73 (0.11)	6.54 (0.11)	4.43 (0.08)	2.73 (0.07)	4.61 (0.10)
Gd	52.0 (0.98)	50.8 (0.88)	39.2 (0.62)	17.1 (0.38)	32.9 (0.62)
Tb	6.9 (0.12)	6.7 (0.12)	4.8 (0.08)	2.0 (0.05)	4.3 (0.09)
Dy	42.0 (0.66)	39.8 (0.63)	28.1 (0.45)	11.3 (0.28)	24.9 (0.45)
Ho	8.2 (0.12)	8.0 (0.15)	5.3 (0.09)	2.2 (0.05)	4.8 (0.07)
Er	20.9 (0.36)	20.6 (0.30)	13.1 (0.21)	5.4 (0.13)	11.8 (0.21)
Tm	2.4 (0.04)	2.4 (0.05)	1.5 (0.04)	0.6 (0.02)	1.3 (0.02)
Yb	12.0 (0.28)	12.5 (0.32)	7.4 (0.15)	3.1 (0.12)	6.5 (0.13)
Lu	1.6 (0.05)	1.8 (0.05)	1.0 (0.03)	≤ LOD	0.9 (0.02)
∑REE + Y	782.1 (3.4)	844.6 (5.5)	609.1 (2.6)	372.9 (3.5)	481.4 (2.1)
$(La/Lu)_{CN}$	4.00 (0.80)	4.43 (0.99)	5.22 (1.05)	9.74 (2.36)	4.42 (0.89)
$(La/Sm)_{CN}$	0.93 (0.15)	1.09 (0.22)	0.96 (0.15)	1.52 (0.31)	0.89 (0.15)
$(La/Y)_{CN}$	2.36 (0.37)	2.85 (0.55)	3.14 (0.47)	6.42 (1.27)	2.67 (0.44)
Eu_A = Eu/Eu*	0.37 (0.01)	0.42 (0.02)	0.37 (0.01)	0.47 (0.02)	0.47 (0.02)
Ce_A = Ce/Ce*	1.03 (0.04)	1.04 (0.05)	1.04 (0.04)	1.08 (0.05)	1.02 (0.04)

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TABLE C6. *(continued)*

Sample (ppm)	C1820_S_7	C1820_S_8	C1820_S_9	C1820_S_10	C1820_S_11	C1820_S_12	C1820_S_13	C1820_S_14	C1820_S_15
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.8)	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.8 (0.3)	1.6 (0.7)	≤ LOD	1.3 (0.3)	1.6 (0.5)	1.4 (0.3)	1.1 (0.3)	1.2 (0.3)	4.7 (2.0)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	21 (21.0)	≤ LOD	≤ LOD	27 (21.0)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	130 (100.0)	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	3 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	4 (0.3)	3 (0.2)	3 (0.2)	4 (0.2)	4 (0.2)	3 (0.4)	3 (0.2)	3 (0.2)	3 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	99.2 (1.4)	104.2 (1.7)	99.0 (1.1)	100.5 (1.6)	131.0 (12.0)	105.2 (1.7)	105.1 (1.4)	103.2 (1.5)	100.7 (1.6)
Y	115.2 (1.4)	101.0 (1.4)	92.8 (0.9)	109.1 (1.3)	167.8 (2.8)	72.8 (1.9)	66.1 (0.8)	72.6 (1.0)	56.7 (0.8)
Mo	869 (13.0)	612 (12.0)	602 (8.4)	869 (11.0)	435 (5.9)	531 (17.0)	933 (15.0)	623 (9.3)	782 (9.8)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	743000 (13000)	738000 (11000)	743000 (10000)	747000 (12000)	737000 (12000)	720000 (11000)	743000 (12000)	743000 (12000)	750000 (8800)
La	63.4 (0.87)	50.0 (0.59)	43.7 (0.41)	58.3 (0.87)	45.3 (0.97)	38.8 (1.00)	47.6 (0.51)	40.7 (0.46)	30.4 (0.68)
Ce	170.8 (2.60)	138.4 (1.90)	126.8 (1.40)	159.5 (2.10)	146.9 (2.90)	114.5 (3.30)	131.4 (1.70)	115.3 (1.60)	97.7 (2.10)
Pr	25.3 (0.38)	21.4 (0.33)	19.7 (0.20)	24.3 (0.31)	23.7 (0.50)	17.4 (0.44)	19.5 (0.28)	17.1 (0.20)	15.6 (0.23)
Nd	134.8 (2.10)	117.4 (1.80)	107.5 (1.10)	131.4 (2.00)	136.6 (2.50)	94.9 (2.40)	103.3 (1.40)	91.0 (1.40)	88.1 (1.40)
Sm	34.5 (0.68)	31.3 (0.49)	27.6 (0.43)	33.8 (0.63)	39.6 (0.87)	23.0 (0.62)	25.0 (0.49)	23.0 (0.46)	21.5 (0.40)
Eu	4.35 (0.10)	4.30 (0.09)	4.22 (0.07)	4.11 (0.09)	4.94 (0.10)	3.07 (0.08)	4.14 (0.09)	3.77 (0.09)	3.50 (0.07)
Gd	38.4 (0.72)	35.7 (0.65)	32.0 (0.50)	38.0 (0.60)	49.3 (0.91)	24.9 (0.65)	26.6 (0.52)	24.8 (0.43)	23.6 (0.44)
Tb	4.9 (0.11)	4.5 (0.08)	3.9 (0.06)	4.7 (0.07)	6.6 (0.11)	3.0 (0.08)	3.1 (0.04)	3.1 (0.06)	2.6 (0.05)
Dy	28.2 (0.54)	26.1 (0.45)	23.2 (0.35)	27.5 (0.45)	40.3 (0.80)	18.1 (0.53)	17.8 (0.32)	17.9 (0.36)	14.5 (0.25)
Ho	5.5 (0.11)	5.0 (0.08)	4.5 (0.07)	5.2 (0.10)	7.9 (0.15)	3.5 (0.10)	3.4 (0.06)	3.5 (0.08)	2.8 (0.05)
Er	13.7 (0.27)	12.5 (0.24)	11.2 (0.16)	13.0 (0.20)	20.1 (0.38)	8.9 (0.27)	8.3 (0.16)	8.6 (0.16)	7.1 (0.15)
Tm	1.6 (0.04)	1.3 (0.03)	1.2 (0.02)	1.4 (0.03)	2.2 (0.05)	1.0 (0.04)	0.9 (0.03)	0.9 (0.02)	0.8 (0.02)
Yb	7.9 (0.15)	7.1 (0.18)	6.1 (0.13)	7.2 (0.17)	10.9 (0.23)	5.5 (0.15)	4.7 (0.13)	4.8 (0.10)	4.0 (0.09)
Lu	1.1 (0.03)	1.0 (0.03)	0.9 (0.02)	1.0 (0.03)	1.5 (0.05)	0.8 (0.02)	0.7 (0.02)	0.7 (0.02)	0.6 (0.02)
∑REE + Y	649.6 (3.7)	556.8 (2.9)	505.3 (2.0)	618.4 (3.2)	703.5 (4.3)	430.1 (4.4)	462.5 (2.4)	427.7 (2.3)	369.4 (2.7)
$(La/Lu)_{CN}$	5.79 (1.15)	5.20 (1.05)	5.00 (0.89)	5.96 (1.22)	3.15 (0.72)	5.19 (1.24)	7.36 (1.48)	5.95 (1.25)	5.24 (1.29)
$(La/Sm)_{CN}$	1.15 (0.21)	1.00 (0.17)	0.99 (0.16)	1.08 (0.20)	0.72 (0.15)	1.06 (0.24)	1.19 (0.21)	1.11 (0.20)	0.89 (0.18)
$(La/Y)_{CN}$	3.66 (0.59)	3.29 (0.53)	3.13 (0.43)	3.55 (0.58)	1.79 (0.35)	3.54 (0.81)	4.78 (0.72)	3.72 (0.58)	3.56 (0.68)
$Eu_A = Eu/Eu^*$	0.36 (0.02)	0.39 (0.02)	0.43 (0.02)	0.35 (0.01)	0.34 (0.01)	0.39 (0.02)	0.48 (0.02)	0.48 (0.02)	0.47 (0.02)
$Ce_A = Ce/Ce^*$	1.02 (0.04)	1.01 (0.04)	1.03 (0.04)	1.02 (0.04)	1.06 (0.05)	1.05 (0.06)	1.03 (0.04)	1.05 (0.04)	1.07 (0.05)

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TABLE C6. *(continued)*

Sample (ppm)	C1820_S_16	C1820_S_17	C1820_S_18	C1820_S_19	C1820_S_20
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	44 (81.0)	220 (140.0)	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	11 (6.4)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	2 (1.3)	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	1 (4.1)	≤ LOD	≤ LOD
Mn	1.8 (0.3)	≤ LOD	5.1 (3.0)	1.0 (0.3)	≤ LOD
Fe	≤ LOD	≤ LOD	650 (360.0)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	130 (100.0)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	82 (57.0)	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	28 (19.0)	≤ LOD	≤ LOD
As	3 (0.2)	3 (0.2)	21 (14.0)	3 (0.2)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	107.7 (1.9)	122.7 (2.4)	104.8 (1.7)	111.3 (2.6)	97.2 (1.9)
Y	95.5 (1.6)	51.8 (0.8)	140.0 (2.1)	92.3 (2.6)	91.1 (1.7)
Mo	777 (11.0)	881 (15.0)	509 (7.0)	645 (14.0)	725 (12.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	1.6 (1.2)	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	6 (2.7)	≤ LOD	≤ LOD
W	736000 (10000)	736000 (12000)	718000 (12000)	745000 (15000)	740000 (11000)
La	45.3 (0.71)	52.7 (0.89)	42.5 (0.41)	52.8 (0.99)	54.6 (0.73)
Ce	126.7 (2.00)	149.2 (2.60)	125.2 (1.70)	143.2 (2.70)	159.9 (2.50)
Pr	19.4 (0.28)	21.5 (0.34)	20.0 (0.33)	21.2 (0.37)	24.3 (0.45)
Nd	107.0 (1.90)	110.4 (1.50)	114.6 (1.60)	114.5 (1.90)	132.2 (2.70)
Sm	29.0 (0.57)	24.9 (0.46)	35.2 (0.62)	29.6 (0.62)	32.5 (0.69)
Eu	3.69 (0.08)	4.09 (0.10)	5.41 (0.11)	4.14 (0.09)	4.23 (0.09)
Gd	33.0 (0.67)	24.2 (0.40)	44.7 (0.66)	33.2 (0.84)	35.4 (0.72)
Tb	4.1 (0.08)	2.6 (0.05)	5.8 (0.10)	4.0 (0.11)	4.0 (0.08)
Dy	23.9 (0.39)	13.7 (0.27)	34.9 (0.53)	23.0 (0.65)	23.1 (0.46)
Ho	4.6 (0.08)	2.5 (0.06)	6.7 (0.11)	4.5 (0.14)	4.5 (0.08)
Er	11.3 (0.23)	6.0 (0.15)	17.0 (0.28)	11.3 (0.30)	11.3 (0.25)
Tm	1.3 (0.03)	0.7 (0.02)	1.8 (0.04)	1.2 (0.04)	1.2 (0.03)
Yb	6.2 (0.15)	3.2 (0.11)	9.1 (0.16)	6.4 (0.21)	6.4 (0.15)
Lu	0.9 (0.03)	≤ LOD	1.2 (0.03)	0.9 (0.03)	1.0 (0.03)
∑REE + Y	511.7 (3.0)	467.9 (3.2)	604.1 (2.6)	542.2 (3.7)	585.8 (3.9)
$(La/Lu)_{CN}$	5.45 (1.17)	12.18 (2.73)	3.54 (0.67)	5.84 (1.30)	5.86 (1.18)
$(La/Sm)_{CN}$	0.98 (0.18)	1.33 (0.25)	0.76 (0.12)	1.12 (0.22)	1.05 (0.20)
$(La/Y)_{CN}$	3.15 (0.57)	6.77 (1.22)	2.02 (0.32)	3.80 (0.82)	3.98 (0.71)
Eu_A = Eu/Eu*	0.36 (0.02)	0.50 (0.02)	0.41 (0.02)	0.40 (0.02)	0.38 (0.02)
Ce_A = Ce/Ce*	1.02 (0.05)	1.06 (0.05)	1.02 (0.04)	1.03 (0.05)	1.05 (0.05)

TABLE C7. Emerald, BC, Canada (C1823).

Sample (ppm)	C1823_S_1	C1823_S_2
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	50.7 (0.7)	64.1 (1.2)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	3 (0.2)	1 (0.1)
Rb	≤ LOD	≤ LOD
Sr	19.0 (0.4)	15.6 (0.3)
Y	81.3 (1.0)	38.8 (0.6)
Mo	50750 (660.0)	43050 (560.0)
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	760000 (10000)	777000 (13000)
La	201.1 (1.90)	119.8 (1.60)
Ce	332.2 (3.80)	200.8 (2.80)
Pr	33.6 (0.40)	20.2 (0.31)
Nd	121.6 (1.40)	69.6 (0.97)
Sm	23.2 (0.40)	11.7 (0.27)
Eu	2.41 (0.06)	1.69 (0.04)
Gd	20.4 (0.45)	9.3 (0.27)
Tb	3.0 (0.06)	1.3 (0.04)
Dy	18.6 (0.36)	7.9 (0.17)
Ho	3.4 (0.07)	1.5 (0.04)
Er	8.4 (0.15)	3.8 (0.10)
Tm	1.0 (0.03)	0.5 (0.02)
Yb	5.3 (0.12)	2.7 (0.09)
Lu	0.5 (0.02)	≤ LOD
∑REE + Y	856.1 (4.6)	489.9 (3.4)
$(La/Lu)_{CN}$	39.58 (9.13)	43.98 (11.35)
$(La/Sm)_{CN}$	5.44 (0.89)	6.45 (1.23)
$(La/Y)_{CN}$	16.44 (2.40)	20.53 (3.44)
Eu_A = Eu/Eu*	0.33 (0.01)	0.48 (0.02)
Ce_A = Ce/Ce*	0.89 (0.04)	0.90 (0.04)

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TABLE C7. *(continued)*

Sample (ppm)	C1823_S_3	C1823_S_4	C1823_S_5	C1823_S_6	C1823_S_7	C1823_S_8	C1823_S_9	C1823_S_10	C1823_S_11
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	56.8 (1.1)	73.6 (1.0)	56.5 (1.1)	58.5 (1.0)	62.1 (2.2)	53.9 (1.0)	53.3 (1.1)	54.4 (1.0)	48.7 (1.0)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	209 (56.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	3 (0.3)	2 (0.2)	3 (0.2)	3 (0.2)	3 (0.2)	3 (0.2)	3 (0.2)	2 (0.2)	2 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	20.9 (0.3)	15.0 (0.3)	21.0 (0.3)	21.1 (0.3)	21.9 (0.4)	19.7 (0.4)	22.3 (0.3)	18.2 (0.4)	18.6 (0.3)
Y	96.4 (1.3)	63.2 (0.7)	105.8 (1.7)	60.8 (0.8)	106.9 (1.4)	79.6 (2.0)	90.5 (1.0)	51.0 (0.8)	42.9 (0.8)
Mo	51500 (750.0)	38340 (450.0)	55630 (800.0)	49180 (660.0)	53050 (660.0)	52280 (790.0)	54340 (690.0)	49530 (740.0)	52480 (900.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	751000 (11000)	796000 (12000)	757000 (12000)	756500 (9600)	761000 (12000)	746000 (12000)	751000 (11000)	762000 (13000)	742000 (14000)
La	268.9 (3.00)	177.5 (2.00)	277.0 (3.60)	289.3 (3.20)	260.0 (3.20)	215.0 (7.20)	259.6 (3.00)	131.1 (1.70)	112.6 (1.60)
Ce	412.9 (4.30)	302.4 (3.90)	437.2 (6.40)	482.8 (6.00)	411.4 (5.10)	344.4 (9.70)	407.3 (5.20)	214.6 (3.40)	185.4 (3.00)
Pr	40.1 (0.52)	26.8 (0.39)	43.8 (0.66)	45.9 (0.69)	41.7 (0.65)	34.5 (0.87)	40.0 (0.46)	22.0 (0.34)	19.3 (0.35)
Nd	138.8 (1.70)	81.1 (1.30)	155.3 (2.40)	159.0 (2.40)	149.4 (2.10)	123.0 (2.80)	140.8 (2.20)	75.7 (1.30)	67.8 (1.10)
Sm	25.7 (0.42)	14.4 (0.34)	29.2 (0.65)	28.8 (0.54)	30.6 (0.45)	23.8 (0.63)	27.7 (0.46)	14.5 (0.33)	13.4 (0.34)
Eu	2.67 (0.07)	1.82 (0.05)	2.82 (0.06)	3.19 (0.08)	2.61 (0.06)	2.38 (0.07)	2.68 (0.06)	1.65 (0.04)	1.29 (0.05)
Gd	22.4 (0.48)	12.3 (0.29)	25.0 (0.47)	21.1 (0.42)	26.9 (0.48)	19.7 (0.56)	23.1 (0.40)	12.5 (0.26)	11.2 (0.33)
Tb	3.4 (0.05)	2.0 (0.04)	3.8 (0.08)	2.8 (0.05)	4.1 (0.07)	3.0 (0.09)	3.4 (0.06)	1.9 (0.04)	1.7 (0.05)
Dy	21.1 (0.34)	13.0 (0.22)	23.2 (0.33)	15.1 (0.29)	24.6 (0.38)	17.7 (0.41)	20.3 (0.32)	11.6 (0.23)	10.2 (0.22)
Ho	3.9 (0.06)	2.4 (0.05)	4.3 (0.07)	2.4 (0.05)	4.3 (0.07)	3.2 (0.08)	3.5 (0.06)	2.1 (0.05)	1.8 (0.04)
Er	9.9 (0.17)	6.7 (0.15)	10.9 (0.18)	5.6 (0.11)	10.8 (0.21)	8.1 (0.20)	9.1 (0.14)	5.3 (0.10)	4.5 (0.10)
Tm	1.2 (0.02)	0.9 (0.03)	1.3 (0.04)	0.7 (0.02)	1.3 (0.03)	1.0 (0.03)	1.1 (0.03)	0.7 (0.02)	0.5 (0.02)
Yb	6.4 (0.11)	5.0 (0.12)	7.2 (0.15)	3.3 (0.10)	6.4 (0.20)	5.0 (0.14)	5.8 (0.16)	3.4 (0.11)	2.6 (0.10)
Lu	0.7 (0.02)	0.5 (0.02)	0.8 (0.02)	≤ LOD	0.7 (0.02)	0.5 (0.02)	0.6 (0.02)	≤ LOD	≤ LOD
∑REE + Y	1054.4 (5.6)	710.1 (4.6)	1127.5 (7.8)	1121.1 (7.3)	1081.7 (6.5)	881.0 (12.5)	1035.4 (6.5)	548.4 (4.1)	475.4 (3.6)
$(La/Lu)_{CN}$	42.06 (9.16)	33.72 (7.66)	37.01 (7.76)	87.84 (20.06)	38.90 (8.03)	41.69 (10.96)	43.28 (9.54)	37.19 (9.08)	43.83 (10.33)
$(La/Sm)_{CN}$	6.56 (1.09)	7.72 (1.44)	5.94 (1.11)	6.29 (1.09)	5.33 (0.88)	5.66 (1.39)	5.87 (0.98)	5.66 (1.07)	5.27 (1.05)
$(La/Y)_{CN}$	18.54 (2.91)	18.66 (2.77)	17.40 (2.97)	31.65 (4.98)	16.17 (2.58)	17.95 (4.35)	19.08 (2.83)	17.08 (2.87)	17.46 (3.18)
$Eu_A = Eu/Eu^*$	0.33 (0.01)	0.41 (0.02)	0.31 (0.01)	0.38 (0.02)	0.27 (0.01)	0.33 (0.02)	0.31 (0.01)	0.36 (0.02)	0.31 (0.02)
$Ce_A = Ce/Ce^*$	0.86 (0.04)	0.95 (0.04)	0.87 (0.04)	0.92 (0.04)	0.87 (0.04)	0.88 (0.06)	0.87 (0.04)	0.88 (0.04)	0.88 (0.04)

(continued on next page)

TABLE C7. *(continued)*

Sample (ppm)	C1823_S_12	C1823_S_13	C1823_S_14	C1823_S_15	C1823_S_16	C1823_S_17	C1823_S_18	C1823_S_19	C1823_S_20
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	43.2 (0.7)	52.4 (0.7)	61.1 (1.0)	64.5 (1.0)	66.4 (1.1)	63.6 (1.1)	57.2 (1.1)	71.0 (1.8)	69.9 (1.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	171 (11.0)	≤ LOD	115 (32.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1 (0.2)	1 (0.2)	2 (0.2)	2 (0.2)	2 (0.2)	1 (0.2)	1 (0.1)	2 (0.2)	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	18.6 (0.3)	17.9 (0.3)	18.7 (0.3)	16.6 (0.3)	16.9 (0.3)	17.5 (0.2)	14.9 (0.3)	18.1 (0.3)	14.3 (0.3)
Y	40.5 (0.6)	25.8 (0.3)	60.7 (0.9)	131.4 (5.2)	55.8 (0.8)	40.2 (0.5)	39.4 (0.6)	143.4 (2.5)	50.6 (0.6)
Mo	52540 (800.0)	48740 (520.0)	48390 (650.0)	40010 (620.0)	43960 (510.0)	46940 (520.0)	39790 (720.0)	36710 (410.0)	32120 (350.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	752000 (10000)	763000 (9500)	759000 (11000)	774000 (13000)	754000 (12000)	753700 (9300)	761000 (12000)	780000 (9700)	785700 (9600)
La	109.8 (1.20)	112.3 (1.20)	166.1 (1.90)	270.2 (4.80)	162.7 (1.60)	114.7 (1.40)	192.4 (2.70)	215.4 (3.60)	141.1 (1.30)
Ce	180.8 (2.30)	196.7 (2.60)	262.5 (3.90)	467.8 (7.80)	270.1 (3.90)	188.3 (2.30)	296.7 (4.00)	374.9 (5.50)	256.8 (2.70)
Pr	18.6 (0.31)	20.1 (0.29)	26.2 (0.38)	44.8 (0.64)	26.9 (0.40)	19.0 (0.29)	26.7 (0.46)	35.8 (0.53)	25.6 (0.36)
Nd	67.4 (1.00)	69.5 (1.10)	90.1 (1.40)	153.1 (2.30)	91.6 (1.50)	66.3 (0.97)	78.9 (1.30)	121.9 (2.00)	84.4 (1.20)
Sm	13.5 (0.26)	13.4 (0.30)	16.9 (0.31)	30.1 (0.64)	16.3 (0.36)	12.2 (0.26)	12.4 (0.35)	26.3 (0.53)	15.1 (0.36)
Eu	1.28 (0.04)	1.45 (0.05)	1.97 (0.06)	4.47 (0.11)	2.17 (0.05)	1.50 (0.05)	2.41 (0.07)	4.14 (0.10)	2.62 (0.07)
Gd	11.3 (0.28)	9.5 (0.18)	14.2 (0.35)	26.1 (0.50)	13.0 (0.28)	10.2 (0.30)	9.9 (0.15)	23.6 (0.58)	11.4 (0.22)
Tb	1.7 (0.04)	1.3 (0.03)	2.2 (0.04)	4.2 (0.12)	1.9 (0.04)	1.5 (0.04)	1.4 (0.05)	4.1 (0.09)	1.8 (0.05)
Dy	10.0 (0.21)	6.7 (0.15)	13.5 (0.26)	27.0 (0.89)	11.7 (0.20)	9.2 (0.23)	8.8 (0.27)	27.7 (0.51)	10.7 (0.18)
Ho	1.7 (0.04)	1.1 (0.03)	2.5 (0.05)	5.0 (0.18)	2.2 (0.05)	1.6 (0.04)	1.5 (0.05)	5.4 (0.10)	2.0 (0.04)
Er	4.3 (0.12)	2.4 (0.07)	6.2 (0.14)	14.1 (0.65)	5.7 (0.12)	4.2 (0.12)	3.9 (0.12)	15.2 (0.20)	5.2 (0.13)
Tm	0.5 (0.01)	≤ LOD	0.8 (0.02)	1.9 (0.10)	0.8 (0.03)	0.5 (0.02)	0.5 (0.03)	2.1 (0.05)	0.7 (0.02)
Yb	2.4 (0.09)	1.3 (0.06)	4.3 (0.10)	10.4 (0.51)	4.3 (0.11)	2.7 (0.11)	2.8 (0.10)	12.0 (0.23)	3.7 (0.11)
Lu	≤ LOD	≤ LOD	≤ LOD	1.0 (0.05)	≤ LOD	≤ LOD	≤ LOD	1.2 (0.04)	≤ LOD
∑REE + Y	464.0 (2.8)	461.8 (3.1)	668.5 (4.6)	1191.5 (9.6)	665.5 (4.5)	472.3 (2.9)	677.8 (5.0)	1013.1 (7.0)	612.0 (3.3)
$(La/Lu)_{CN}$	45.84 (11.54)	93.77 (28.22)	38.39 (8.91)	27.37 (7.17)	39.36 (9.74)	42.41 (10.58)	80.98 (23.35)	17.91 (3.79)	39.17 (9.17)
$(La/Sm)_{CN}$	5.10 (0.89)	5.26 (0.96)	6.17 (1.07)	5.63 (1.11)	6.26 (1.12)	5.89 (1.08)	9.70 (1.99)	5.13 (0.98)	5.85 (1.06)
$(La/Y)_{CN}$	18.01 (2.94)	28.95 (4.40)	18.19 (2.91)	13.67 (3.27)	19.38 (2.97)	18.99 (3.00)	32.49 (5.63)	9.98 (1.85)	18.52 (2.70)
$Eu_A = Eu/Eu^*$	0.31 (0.02)	0.37 (0.02)	0.38 (0.02)	0.47 (0.02)	0.44 (0.02)	0.40 (0.02)	0.64 (0.03)	0.49 (0.02)	0.58 (0.03)
$Ce_A = Ce/Ce^*$	0.89 (0.04)	0.93 (0.04)	0.87 (0.04)	0.94 (0.04)	0.90 (0.04)	0.89 (0.04)	0.88 (0.04)	0.94 (0.04)	0.96 (0.04)

TABLE C8. Kalzas, YT, Canada (CMNOC 1194).

Sample (ppm)	CMNOC1194_S_1	CMNOC1194_S_2	CMNOC1194_S_3	CMNOC1194_S_4	CMNOC1194_S_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	35.9 (0.7)	52.5 (0.9)	49.2 (0.9)	56.0 (0.8)	54.9 (0.9)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	175.8 (1.9)	177.7 (1.9)	224.2 (2.7)	161.1 (1.9)	158.7 (1.9)
Y	160.1 (1.8)	82.1 (0.9)	34.8 (0.5)	40.2 (0.6)	133.6 (1.5)
Mo	8 (0.3)	6 (0.3)	7 (0.3)	5 (0.3)	5 (0.3)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	817000 (13000)	819000 (11000)	808000 (11000)	808000 (12000)	814000 (11000)
La	15.1 (0.32)	15.7 (0.33)	0.3 (0.02)	3.7 (0.09)	31.1 (0.73)
Ce	38.7 (0.57)	18.9 (0.37)	0.1 (0.01)	1.3 (0.05)	50.3 (0.89)
Pr	4.7 (0.09)	1.3 (0.04)	≤ LOD	≤ LOD	3.9 (0.08)
Nd	19.0 (0.33)	2.9 (0.13)	≤ LOD	≤ LOD	9.3 (0.17)
Sm	6.5 (0.16)	0.6 (0.06)	≤ LOD	≤ LOD	1.9 (0.10)
Eu	14.14 (0.25)	18.76 (0.25)	4.27 (0.10)	9.05 (0.18)	21.22 (0.31)
Gd	9.9 (0.23)	1.3 (0.08)	0.4 (0.05)	0.6 (0.05)	2.4 (0.11)
Tb	2.2 (0.04)	0.5 (0.02)	0.3 (0.02)	0.3 (0.02)	0.8 (0.02)
Dy	18.2 (0.26)	7.3 (0.18)	4.0 (0.10)	4.7 (0.15)	8.9 (0.19)
Ho	4.5 (0.08)	2.5 (0.05)	1.4 (0.04)	1.7 (0.04)	2.7 (0.06)
Er	16.7 (0.28)	11.8 (0.20)	6.7 (0.12)	7.8 (0.18)	12.6 (0.22)
Tm	3.2 (0.06)	2.7 (0.05)	1.5 (0.04)	1.7 (0.05)	3.1 (0.06)
Yb	24.1 (0.45)	23.6 (0.34)	12.0 (0.25)	13.8 (0.28)	27.4 (0.44)
Lu	3.3 (0.06)	3.6 (0.05)	1.7 (0.03)	2.1 (0.04)	4.3 (0.06)
∑REE + Y	340.2 (1.0)	193.4 (0.7)	67.6 (0.3)	87.1 (0.4)	313.6 (1.3)
$(La/Lu)_{CN}$	0.48 (0.10)	0.46 (0.08)	0.02 (0.01)	0.19 (0.04)	0.76 (0.15)
$(La/Sm)_{CN}$	1.46 (0.31)	15.26 (5.20)	1.85 (0.91)	18.44 (8.33)	10.39 (2.87)
$(La/Y)_{CN}$	0.63 (0.11)	1.27 (0.23)	0.06 (0.02)	0.62 (0.12)	1.55 (0.29)
$Eu_A = Eu/Eu^*$	5.35 (0.24)	62.03 (6.99)	52.37 (9.90)	87.80 (14.75)	30.23 (2.28)
$Ce_A = Ce/Ce^*$	1.10 (0.05)	0.77 (0.04)	0.21 (0.03)	0.27 (0.02)	0.94 (0.05)

TABLE C9. Crane, ON, Canada (CMNMC 40242).

Sample (ppm)	CMNMC40242_S_1	CMNMC40242_S_2	CMNMC40242_S_3	CMNMC40242_S_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	1 (0.6)	≤ LOD
Mn	9.3 (0.5)	8.9 (0.5)	9.5 (0.5)	10.3 (0.5)
Fe	51 (17.0)	3 (0.7)	3 (0.7)	5 (0.8)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	2 (0.2)	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	5 (0.4)	4 (0.4)	6 (0.4)	8 (0.6)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	591.2 (6.6)	563.1 (5.4)	582.3 (5.8)	601.4 (6.5)
Y	177.0 (2.5)	171.8 (2.0)	180.8 (1.9)	184.1 (2.6)
Mo	496 (5.9)	498 (7.3)	475 (5.1)	695 (21.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	2 (0.2)
W	1033000 (12000)	1048000 (13000)	1049000 (12000)	1061000 (15000)
La	2.9 (0.10)	2.2 (0.07)	2.4 (0.06)	3.1 (0.16)
Ce	17.2 (0.49)	13.6 (0.33)	13.8 (0.23)	15.2 (0.57)
Pr	4.4 (0.08)	3.6 (0.08)	3.8 (0.08)	4.1 (0.15)
Nd	33.6 (0.73)	27.9 (0.50)	31.4 (0.55)	33.0 (0.80)
Sm	18.0 (0.37)	15.2 (0.43)	17.8 (0.45)	18.4 (0.41)
Eu	7.22 (0.13)	5.99 (0.09)	6.73 (0.16)	7.25 (0.15)
Gd	32.7 (0.55)	25.9 (0.45)	32.6 (0.76)	33.3 (0.56)
Tb	6.2 (0.09)	5.2 (0.09)	6.3 (0.11)	6.5 (0.12)
Dy	44.7 (0.73)	39.5 (0.63)	45.8 (0.84)	47.2 (0.97)
Ho	8.3 (0.13)	7.8 (0.11)	8.7 (0.14)	8.9 (0.14)
Er	17.5 (0.32)	17.8 (0.31)	18.8 (0.27)	19.4 (0.36)
Tm	1.6 (0.04)	1.7 (0.03)	1.8 (0.04)	1.8 (0.05)
Yb	5.3 (0.16)	5.6 (0.15)	5.9 (0.17)	6.0 (0.17)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	376.9 (1.4)	344.1 (1.1)	376.8 (1.4)	388.5 (1.6)
$(La/Lu)_{CN}$	0.91 (0.26)	0.61 (0.17)	0.64 (0.17)	0.85 (0.27)
$(La/Sm)_{CN}$	0.10 (0.02)	0.09 (0.02)	0.08 (0.02)	0.11 (0.03)
$(La/Y)_{CN}$	0.11 (0.02)	0.09 (0.02)	0.09 (0.02)	0.11 (0.03)
Eu_A = Eu/Eu*	0.89 (0.04)	0.91 (0.04)	0.84 (0.04)	0.88 (0.04)
Ce_A = Ce/Ce*	0.93 (0.06)	0.90 (0.06)	0.87 (0.05)	0.85 (0.07)

TABLE C10. Flat River, NWT, Canada (CMNMC 40248).

Sample (ppm)	CMNMC40248_A_1	CMNMC40248_A_2	CMNMC40248_A_3	CMNMC40248_A_4	CMNMC40248_A_5	CMNMC40248_A_6	CMNMC40248_A_7
Li	7 (8.4)	3 (4.8)	≤ LOD	6 (5.1)	5 (5.2)	6 (5.5)	4 (4.6)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	120 (230.0)	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	4 (16.0)	13 (10.0)	3 (13.0)	≤ LOD	6 (8.5)	≤ LOD	2 (13.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (2.9)	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	11.0 (11.0)	31.0 (11.0)	26.8 (8.9)	24.7 (6.9)	73.0 (59.0)	13.0 (11.0)	9.0 (11.0)
Fe	≤ LOD	≤ LOD	≤ LOD	5 (15.0)	50 (47.0)	26 (25.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	3 (7.7)	5 (17.0)	3 (8.5)	2 (6.3)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	2 (3.1)	≤ LOD	≤ LOD	≤ LOD	2 (3.4)	4 (1.9)
Zn	≤ LOD	3 (2.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	3 (3.1)	2 (2.1)	5 (2.3)	4 (1.6)	5 (1.7)	3 (1.6)	4 (2.9)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	85.0 (10.0)	87.6 (4.8)	84.8 (5.5)	79.5 (7.5)	86.2 (6.8)	92.1 (6.3)	86.2 (9.6)
Y	600.0 (61.0)	1370.0 (370.0)	1090.0 (170.0)	516.0 (31.0)	1040.0 (180.0)	1240.0 (150.0)	840.0 (200.0)
Mo	56 (7.4)	51 (7.8)	55 (5.2)	66 (6.2)	34 (8.9)	32 (6.0)	41 (4.5)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	0.7 (1.0)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.4)	0.9 (0.8)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	950000 (120000)	951000 (63000)	1050000 (71000)	948000 (81000)	970000 (78000)	1039000 (85000)	1030000 (100000)
La	65.3 (5.70)	89.0 (15.00)	73.0 (13.00)	38.7 (7.00)	40.2 (9.90)	49.0 (10.00)	56.0 (15.00)
Ce	261.0 (21.00)	423.0 (83.00)	356.0 (54.00)	175.0 (24.00)	182.0 (36.00)	241.0 (42.00)	233.0 (72.00)
Pr	42.3 (4.30)	74.0 (16.00)	66.5 (7.70)	33.3 (3.70)	38.5 (6.30)	54.2 (7.90)	47.0 (16.00)
Nd	176.0 (17.00)	361.0 (88.00)	351.0 (40.00)	163.0 (17.00)	233.0 (30.00)	364.0 (58.00)	282.0 (98.00)
Sm	45.2 (5.00)	131.0 (42.00)	122.0 (25.00)	52.8 (5.40)	128.0 (26.00)	156.0 (15.00)	103.0 (38.00)
Eu	13.80 (1.50)	15.30 (2.10)	13.30 (1.60)	7.16 (0.71)	10.60 (2.00)	13.30 (1.70)	10.00 (2.30)
Gd	37.2 (5.00)	127.0 (44.00)	128.0 (12.00)	57.0 (6.20)	183.0 (58.00)	178.0 (12.00)	108.0 (38.00)
Tb	8.6 (0.85)	26.4 (9.50)	24.8 (2.90)	11.5 (1.20)	36.0 (13.00)	38.5 (3.20)	21.5 (6.80)
Dy	73.8 (6.40)	226.0 (73.00)	201.0 (20.00)	90.0 (7.70)	263.0 (92.00)	278.0 (22.00)	165.0 (51.00)
Ho	18.0 (1.90)	50.0 (16.00)	41.3 (6.10)	19.6 (2.00)	57.0 (20.00)	52.5 (7.80)	35.0 (11.00)
Er	58.7 (2.30)	173.0 (41.00)	129.0 (22.00)	61.9 (5.00)	152.0 (46.00)	157.0 (23.00)	104.0 (33.00)
Tm	11.1 (0.84)	29.1 (7.50)	19.4 (4.50)	8.4 (0.88)	20.9 (6.50)	18.6 (3.30)	15.4 (4.80)
Yb	70.8 (6.30)	165.0 (30.00)	106.0 (25.00)	51.9 (4.50)	106.0 (26.00)	96.0 (18.00)	80.0 (27.00)
Lu	9.0 (1.30)	17.5 (2.30)	12.7 (3.10)	6.0 (0.70)	10.4 (3.60)	10.4 (2.10)	8.4 (2.60)
∑REE + Y	1490.8 (30.4)	3277.3 (164.7)	2734.0 (84.3)	1292.2 (33.3)	2500.6 (135.1)	2946.5 (84.2)	2108.3 (150.9)
$(La/Lu)_{CN}$	0.75 (0.36)	0.53 (0.29)	0.60 (0.39)	0.67 (0.37)	0.40 (0.31)	0.49 (0.31)	0.69 (0.52)
$(La/Sm)_{CN}$	0.91 (0.40)	0.43 (0.30)	0.38 (0.23)	0.46 (0.24)	0.20 (0.13)	0.20 (0.11)	0.34 (0.27)
$(La/Y)_{CN}$	0.72 (0.31)	0.43 (0.29)	0.45 (0.26)	0.50 (0.24)	0.26 (0.17)	0.26 (0.15)	0.44 (0.32)
$Eu_A = Eu/Eu^*$	0.99 (0.20)	0.36 (0.18)	0.32 (0.09)	0.39 (0.07)	0.21 (0.09)	0.24 (0.04)	0.29 (0.16)
$Ce_A = Ce/Ce^*$	1.15 (0.19)	1.16 (0.43)	1.12 (0.28)	1.08 (0.26)	1.00 (0.34)	0.98 (0.29)	1.01 (0.59)

TABLE C11. Tulare, California, USA (CMNMC 40254).

Sample (ppm)	CMNMC40254_S_1	CMNMC40254_S_2	CMNMC40254_S_3	CMNMC40254_S_4	CMNMC40254_S_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.4 (0.3)	1.7 (0.3)	1.5 (0.4)	1.8 (0.3)	2.3 (0.8)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	73.6 (1.1)	74.0 (0.9)	74.9 (1.0)	75.3 (0.8)	75.2 (0.9)
Y	3.0 (0.1)	3.1 (0.1)	3.3 (0.1)	4.8 (0.1)	4.7 (0.1)
Mo	104 (1.2)	108 (1.5)	109 (2.0)	107 (1.4)	108 (1.9)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	781000 (13000)	799000 (12000)	809000 (11000)	810000 (11000)	806000 (12000)
La	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ce	0.3 (0.02)	0.3 (0.02)	0.3 (0.02)	0.6 (0.02)	0.6 (0.03)
Pr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Nd	≤ LOD	≤ LOD	≤ LOD	0.7 (0.06)	0.8 (0.06)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.3 (0.03)	0.3 (0.03)	0.2 (0.03)	0.5 (0.06)	0.5 (0.05)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.4 (0.03)	0.4 (0.03)	0.5 (0.04)	0.7 (0.04)	0.6 (0.04)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	0.3 (0.03)	0.3 (0.03)	0.4 (0.03)	0.5 (0.03)	0.5 (0.03)
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	0.3 (0.03)	0.3 (0.04)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	5.3 (0.1)	5.4 (0.1)	5.8 (0.1)	8.9 (0.1)	8.9 (0.1)
$(La/Lu)_{CN}$	0.25 (0.13)	0.28 (0.13)	0.22 (0.11)	0.36 (0.17)	0.32 (0.15)
$(La/Sm)_{CN}$	0.27 (0.16)	0.33 (0.18)	0.30 (0.17)	0.28 (0.14)	0.29 (0.12)
$(La/Y)_{CN}$	0.14 (0.06)	0.15 (0.05)	0.13 (0.05)	0.17 (0.06)	0.17 (0.05)
Eu_A = Eu/Eu*	0.30 (0.09)	0.25 (0.08)	0.41 (0.13)	0.27 (0.07)	0.31 (0.07)
Ce_A = Ce/Ce*	1.16 (0.25)	1.10 (0.23)	1.20 (0.22)	1.16 (0.15)	1.08 (0.14)

TABLE C12. Traversella, Italy (CMNMC 40266).

Sample (ppm)	CMNMC40266_A_1	CMNMC40266_A_2	CMNMC40266_A_3	CMNMC40266_A_4	CMNMC40266_A_5	CMNMC40266_A_6	CMNMC40266_A_7	CMNMC40266_A_8
Li	5 (5.2)	≤ LOD	≤ LOD	≤ LOD	10 (11.0)	6 (7.6)	4 (8.7)	10 (7.6)
B	26 (2.0)	29 (1.8)	27 (3.0)	27 (2.4)	26 (3.2)	27 (2.3)	26 (2.5)	23 (2.5)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	90 (190.0)	≤ LOD	≤ LOD
Ti	2 (7.7)	5 (13.0)	≤ LOD	≤ LOD	10 (17.0)	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	2 (7.9)	≤ LOD	5 (10.0)	3 (13.0)	≤ LOD	12 (15.0)	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	3.9 (7.5)	≤ LOD	≤ LOD	≤ LOD	5.8 (5.9)
Fe	2 (12.0)	4 (11.0)	4 (18.0)	22 (21.0)	19 (18.0)	≤ LOD	17 (18.0)	22 (12.0)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	7 (8.4)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (4.3)	≤ LOD	2 (2.1)	4 (1.7)
Zn	≤ LOD	3 (1.9)	≤ LOD	≤ LOD	≤ LOD	2 (2.3)	2 (2.3)	2 (1.6)
As	39 (3.7)	191 (16.0)	127 (14.0)	122 (7.9)	97 (12.0)	21 (5.9)	87 (14.0)	30 (4.4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	78.6 (6.6)	76.7 (5.6)	74.7 (5.2)	64.7 (4.4)	63.4 (5.0)	148.0 (41.0)	64.2 (5.7)	59.7 (4.4)
Y	167.6 (6.4)	303.0 (24.0)	278.0 (19.0)	272.0 (18.0)	258.0 (16.0)	83.0 (23.0)	193.0 (24.0)	122.7 (8.5)
Mo	1180 (52.0)	1153 (86.0)	1143 (66.0)	1132 (71.0)	1099 (72.0)	640 (220.0)	1100 (120.0)	1194 (86.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	934000 (47000)	940000 (66000)	970000 (68000)	892000 (61000)	946000 (73000)	889000 (69000)	869000 (72000)	871000 (57000)
La	25.1 (1.20)	38.0 (3.10)	33.5 (2.70)	33.2 (2.00)	32.4 (2.00)	10.7 (3.40)	29.9 (3.10)	17.5 (1.50)
Ce	97.2 (4.40)	151.0 (12.00)	142.7 (9.40)	134.7 (8.70)	128.5 (7.00)	47.0 (15.00)	118.0 (13.00)	68.3 (4.70)
Pr	23.0 (0.99)	36.7 (2.70)	33.9 (1.90)	33.1 (1.80)	31.5 (2.60)	11.9 (3.90)	26.2 (3.60)	16.6 (1.10)
Nd	169.4 (8.80)	262.0 (21.00)	254.0 (12.00)	252.0 (17.00)	233.0 (20.00)	88.0 (24.00)	186.0 (16.00)	122.3 (6.80)
Sm	61.7 (2.90)	102.1 (8.10)	109.7 (9.70)	97.9 (8.00)	98.6 (5.90)	35.8 (8.30)	77.0 (13.00)	50.8 (4.20)
Eu	2.17 (0.28)	2.57 (0.34)	2.41 (0.49)	1.88 (0.27)	2.18 (0.35)	1.67 (0.31)	1.79 (0.40)	1.10 (0.18)
Gd	74.2 (3.90)	127.0 (11.00)	121.0 (9.40)	114.7 (9.30)	105.7 (6.10)	42.2 (9.90)	87.0 (10.00)	58.7 (4.70)
Tb	8.9 (0.43)	15.8 (1.00)	15.3 (1.40)	15.0 (1.20)	12.9 (0.72)	5.1 (1.10)	10.6 (1.40)	6.6 (0.51)
Dy	50.7 (2.30)	86.2 (6.50)	79.2 (6.20)	80.6 (4.70)	74.8 (4.80)	25.9 (5.90)	64.4 (9.20)	37.2 (2.30)
Ho	8.5 (0.48)	15.3 (1.20)	13.8 (1.30)	13.7 (0.61)	13.0 (0.95)	4.8 (1.10)	10.5 (1.30)	6.6 (0.49)
Er	17.4 (0.89)	31.7 (2.50)	29.3 (2.80)	28.3 (1.70)	25.0 (2.30)	8.7 (2.50)	20.6 (3.50)	13.3 (1.20)
Tm	1.3 (0.13)	2.7 (0.29)	2.5 (0.34)	2.2 (0.27)	2.1 (0.33)	0.7 (0.19)	1.8 (0.31)	1.1 (0.15)
Yb	4.4 (0.55)	9.0 (1.10)	8.3 (1.30)	8.5 (1.10)	6.4 (0.94)	1.9 (0.62)	5.4 (0.95)	3.4 (0.45)
Lu	≤ LOD	0.8 (0.13)	0.8 (0.15)	0.7 (0.12)	≤ LOD	≤ LOD	0.5 (0.17)	≤ LOD
∑REE + Y	711.8 (11.4)	1183.9 (29.0)	1124.4 (21.9)	1088.4 (23.5)	1024.5 (23.7)	367.5 (32.2)	832.6 (28.6)	526.6 (10.9)
$(La/Lu)_{CN}$	6.60 (3.04)	4.98 (2.47)	4.39 (2.28)	5.06 (2.46)	7.14 (4.15)	8.21 (7.02)	6.19 (4.12)	5.51 (2.96)
$(La/Sm)_{CN}$	0.25 (0.08)	0.23 (0.09)	0.19 (0.08)	0.21 (0.08)	0.21 (0.07)	0.19 (0.14)	0.24 (0.13)	0.22 (0.09)
$(La/Y)_{CN}$	1.00 (0.29)	0.83 (0.33)	0.80 (0.31)	0.81 (0.29)	0.83 (0.29)	0.86 (0.66)	1.03 (0.49)	0.95 (0.37)
$Eu_A = Eu/Eu^*$	0.10 (0.01)	0.07 (0.01)	0.06 (0.02)	0.05 (0.01)	0.06 (0.01)	0.13 (0.05)	0.07 (0.02)	0.06 (0.01)
$Ce_A = Ce/Ce^*$	0.88 (0.08)	0.87 (0.13)	0.90 (0.11)	0.87 (0.10)	0.87 (0.12)	0.87 (0.53)	0.93 (0.22)	0.87 (0.12)

(continued on next page)

TABLE C12. *(continued)*

Sample (ppm)	CMNMC40266_A_9	CMNMC40266_A_10	CMNMC40266_S_1	CMNMC40266_S_2	CMNMC40266_S_3
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	23 (2.0)	27 (2.1)	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	3 (11.0)	5 (11.0)	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	2 (8.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.9 (0.7)
Fe	3 (9.9)	≤ LOD	≤ LOD	≤ LOD	2 (2.5)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	2 (4.3)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	3 (1.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	23 (4.2)	8 (2.1)	30 (1.2)	27 (1.2)	26 (1.5)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	67.1 (7.7)	65.2 (4.7)	88.4 (2.1)	56.4 (0.6)	65.4 (0.9)
Y	108.1 (8.0)	32.4 (3.6)	135.9 (1.9)	104.9 (1.0)	108.1 (1.0)
Mo	1066 (76.0)	594 (41.0)	939 (13.0)	998 (11.0)	977 (9.7)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	810000 (61000)	911000 (69000)	806000 (11000)	806000 (10000)	804500 (9300)
La	15.3 (1.20)	6.4 (0.76)	17.4 (0.28)	15.3 (0.16)	15.6 (0.19)
Ce	59.7 (5.10)	20.6 (2.70)	74.9 (0.88)	64.4 (0.76)	65.8 (0.63)
Pr	14.6 (1.20)	4.7 (0.61)	16.9 (0.23)	14.4 (0.17)	14.8 (0.14)
Nd	106.3 (8.80)	35.2 (4.40)	124.4 (1.50)	105.7 (1.40)	107.3 (1.40)
Sm	46.3 (3.70)	13.8 (1.80)	49.4 (0.75)	41.0 (0.73)	40.9 (0.56)
Eu	1.27 (0.25)	2.30 (0.34)	1.44 (0.04)	1.02 (0.03)	1.15 (0.04)
Gd	49.4 (5.50)	18.3 (2.40)	55.7 (0.78)	44.4 (0.68)	45.4 (0.70)
Tb	5.9 (0.42)	2.4 (0.27)	7.0 (0.10)	5.5 (0.09)	5.6 (0.08)
Dy	32.8 (2.90)	13.4 (1.60)	38.4 (0.51)	29.6 (0.46)	30.5 (0.37)
Ho	5.8 (0.51)	2.2 (0.24)	6.4 (0.10)	4.8 (0.06)	5.0 (0.08)
Er	9.5 (1.00)	4.7 (0.66)	13.1 (0.25)	9.5 (0.19)	9.9 (0.16)
Tm	0.8 (0.13)	0.3 (0.08)	1.1 (0.03)	0.8 (0.02)	0.8 (0.03)
Yb	3.0 (0.51)	1.4 (0.42)	3.9 (0.10)	2.5 (0.10)	2.7 (0.10)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	458.9 (12.7)	158.2 (6.3)	546.2 (2.2)	443.9 (2.0)	453.7 (1.8)
$(La/Lu)_{CN}$	8.43 (5.02)	6.19 (4.85)	5.48 (1.29)	8.15 (1.95)	7.76 (2.12)
$(La/Sm)_{CN}$	0.21 (0.08)	0.29 (0.15)	0.22 (0.04)	0.23 (0.04)	0.24 (0.04)
$(La/Y)_{CN}$	0.94 (0.37)	1.31 (0.63)	0.85 (0.15)	0.97 (0.14)	0.96 (0.14)
$Eu_A = Eu/Eu^*$	0.08 (0.02)	0.44 (0.10)	0.08 (0.00)	0.07 (0.00)	0.08 (0.00)
$Ce_A = Ce/Ce^*$	0.86 (0.14)	0.85 (0.20)	0.94 (0.04)	0.94 (0.04)	0.94 (0.04)

TABLE C13. Dae Hwa (Taewha), South Korea (CMNMC 40273).

Sample (ppm)	CMNMC40273_A_1	CMNMC40273_A_2	CMNMC40273_A_3	CMNMC40273_A_4	CMNMC40273_A_5	CMNMC40273_A_6	CMNMC40273_A_7	CMNMC40273_A_8
Li	≤ LOD	12 (8.5)	3 (3.8)	7 (5.4)	3 (3.7)	8 (6.3)	3 (3.7)	≤ LOD
B	25 (2.2)	26 (2.1)	28 (1.5)	29 (1.4)	29 (1.5)	28 (1.8)	29 (1.4)	29 (1.5)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	3 (6.6)	≤ LOD	≤ LOD	7 (10.0)	3 (8.6)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (7.9)
Mn	8.0 (5.6)	2.0 (6.4)	7.2 (4.7)	3.3 (5.0)	7.9 (3.9)	6.3 (5.2)	7.8 (6.0)	5.2 (5.6)
Fe	4 (13.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	2 (1.0)	2 (0.9)	2 (0.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	4290.0 (490.0)	6200.0 (730.0)	6850.0 (380.0)	7300.0 (1100.0)	5410.0 (450.0)	7210.0 (740.0)	3380.0 (250.0)	2880.0 (210.0)
Y	209.0 (26.0)	322.0 (24.0)	196.0 (12.0)	350.0 (21.0)	360.0 (19.0)	378.0 (32.0)	279.0 (31.0)	262.0 (38.0)
Mo	≤ LOD	7 (2.3)	495 (54.0)	15 (4.1)	4 (0.8)	2 (0.8)	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	872000 (47000)	853000 (36000)	928000 (36000)	892000 (31000)	916000 (47000)	893000 (44000)	918000 (34000)	918000 (54000)
La	76.7 (6.70)	63.0 (21.00)	38.7 (4.10)	59.7 (7.50)	68.1 (6.80)	98.0 (12.00)	81.0 (11.00)	81.5 (9.20)
Ce	160.0 (31.00)	258.0 (48.00)	121.6 (8.70)	304.0 (23.00)	310.0 (21.00)	293.0 (30.00)	228.0 (36.00)	220.0 (37.00)
Pr	20.0 (5.20)	45.4 (5.70)	19.8 (1.40)	59.3 (3.70)	56.7 (5.10)	45.6 (5.30)	30.6 (5.00)	29.5 (5.80)
Nd	79.0 (23.00)	239.0 (28.00)	93.9 (8.60)	268.0 (16.00)	281.0 (31.00)	198.0 (28.00)	132.0 (21.00)	128.0 (27.00)
Sm	18.7 (6.00)	76.5 (7.60)	27.2 (2.70)	76.3 (5.70)	73.7 (8.40)	45.1 (7.80)	33.4 (5.20)	30.5 (7.00)
Eu	7.70 (1.60)	22.50 (2.30)	6.08 (0.58)	22.30 (1.50)	22.60 (2.30)	21.40 (3.90)	14.60 (1.80)	13.00 (2.20)
Gd	19.0 (5.50)	88.0 (11.00)	41.7 (3.60)	86.2 (6.10)	84.2 (9.00)	59.0 (10.00)	39.9 (4.80)	30.6 (6.60)
Tb	5.5 (1.30)	16.5 (1.30)	11.4 (0.63)	16.4 (0.77)	15.8 (1.40)	11.7 (1.50)	9.4 (1.10)	7.9 (1.50)
Dy	50.0 (11.00)	128.4 (8.40)	99.5 (5.20)	133.0 (7.10)	133.9 (8.90)	102.0 (11.00)	95.6 (6.60)	74.0 (13.00)
Ho	12.6 (2.40)	26.6 (1.90)	21.9 (1.40)	27.8 (1.40)	25.9 (1.60)	23.1 (2.20)	20.7 (1.70)	17.7 (3.00)
Er	50.2 (8.10)	78.9 (5.20)	68.0 (5.20)	78.0 (4.30)	80.9 (3.90)	81.4 (5.50)	72.2 (5.40)	63.3 (9.80)
Tm	11.9 (1.50)	11.8 (0.84)	11.7 (1.10)	12.0 (1.00)	14.4 (0.79)	16.3 (0.99)	13.8 (1.40)	13.6 (1.80)
Yb	107.4 (8.90)	69.3 (5.90)	68.8 (6.40)	64.1 (7.10)	80.7 (6.80)	123.0 (11.00)	111.7 (9.60)	116.0 (13.00)
Lu	15.6 (1.10)	7.7 (0.99)	7.5 (0.76)	5.9 (0.68)	8.9 (1.00)	14.8 (1.70)	14.4 (1.30)	15.0 (1.20)
∑REE + Y	843.3 (43.7)	1453.5 (62.3)	833.9 (17.0)	1563.0 (32.4)	1616.8 (42.2)	1510.4 (48.1)	1176.3 (45.9)	1102.6 (52.6)
$(La/Lu)_{CN}$	0.51 (0.20)	0.85 (0.58)	0.53 (0.24)	1.05 (0.52)	0.79 (0.36)	0.69 (0.33)	0.58 (0.28)	0.56 (0.25)
$(La/Sm)_{CN}$	2.57 (1.64)	0.52 (0.34)	0.89 (0.40)	0.49 (0.22)	0.58 (0.27)	1.36 (0.74)	1.52 (0.82)	1.67 (0.98)
$(La/Y)_{CN}$	2.44 (1.12)	1.30 (0.83)	1.31 (0.54)	1.13 (0.49)	1.26 (0.49)	1.72 (0.78)	1.93 (0.96)	2.07 (1.05)
$Eu_A = Eu/Eu^*$	1.23 (0.60)	0.83 (0.16)	0.55 (0.09)	0.83 (0.10)	0.87 (0.16)	1.26 (0.38)	1.21 (0.29)	1.28 (0.47)
$Ce_A = Ce/Ce^*$	0.96 (0.30)	1.10 (0.37)	1.04 (0.15)	1.10 (0.16)	1.11 (0.18)	1.05 (0.21)	1.10 (0.29)	1.08 (0.30)

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TABLE C13. *(continued)*

Sample (ppm)	CMNMC40273_ A_9	CMNMC40273_ A_10
Li	3 (3.1)	4 (4.0)
B	30 (1.4)	26 (2.5)
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	5 (7.6)
V	≤ LOD	≤ LOD
Cr	≤ LOD	2 (7.2)
Mn	7.8 (5.4)	2.3 (4.8)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	2 (4.0)	3 (5.2)
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	2 (0.9)	≤ LOD
Rb	≤ LOD	≤ LOD
Sr	3280.0 (280.0)	2444.0 (91.0)
Y	304.0 (23.0)	266.0 (14.0)
Mo	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	926000 (41000)	848000 (46000)
La	74.7 (8.30)	138.2 (8.50)
Ce	226.0 (20.00)	274.0 (16.00)
Pr	34.6 (3.80)	33.7 (3.60)
Nd	162.0 (22.00)	122.0 (15.00)
Sm	45.4 (8.00)	26.8 (2.80)
Eu	21.30 (2.40)	16.50 (1.10)
Gd	54.6 (8.00)	32.3 (3.50)
Tb	12.2 (1.40)	7.7 (0.55)
Dy	104.3 (9.30)	74.1 (4.20)
Ho	22.1 (1.60)	17.6 (1.00)
Er	77.4 (5.50)	64.1 (3.60)
Tm	14.8 (1.30)	13.1 (0.79)
Yb	107.0 (11.00)	106.7 (6.10)
Lu	12.7 (1.50)	12.9 (0.77)
∑REE + Y	1273.1 (36.7)	1205.7 (25.6)
$(La/Lu)_{CN}$	0.61 (0.29)	1.11 (0.39)
$(La/Sm)_{CN}$	1.03 (0.55)	3.23 (1.32)
$(La/Y)_{CN}$	1.63 (0.71)	3.45 (1.17)
Eu_A = Eu/Eu*	1.30 (0.34)	1.70 (0.28)
Ce_A = Ce/Ce*	1.06 (0.19)	0.94 (0.12)

TABLE C14. Guadalupana, Sonora, Mexico (CMNMC 40276).

Sample (ppm)	CMNMC40276 _S_1	CMNMC40276 _S_2	CMNMC40276 _S_3	CMNMC40276_ S_4	CMNMC40276_ S_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	3.2 (0.3)	3.2 (0.3)	3.2 (0.3)	3.3 (0.4)	3.5 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	29 (1.1)	29 (1.4)	30 (1.2)	30 (1.1)	32 (1.5)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	83.3 (1.1)	81.3 (1.0)	83.3 (1.2)	82.2 (0.9)	81.4 (0.9)
Y	215.2 (2.1)	212.6 (2.6)	221.4 (2.1)	223.3 (2.2)	228.5 (2.1)
Mo	2189 (24.0)	2191 (28.0)	2214 (28.0)	2223 (27.0)	2260 (31.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	804100 (8800)	809000 (10000)	810000 (11000)	805000 (12000)	801000 (12000)
La	17.3 (0.22)	16.9 (0.20)	18.1 (0.25)	18.5 (0.28)	19.0 (0.21)
Ce	82.5 (0.81)	80.8 (0.99)	85.7 (0.94)	90.0 (1.20)	92.2 (1.00)
Pr	19.8 (0.22)	19.3 (0.26)	20.2 (0.29)	21.0 (0.29)	21.8 (0.26)
Nd	143.6 (1.70)	141.0 (1.70)	147.5 (1.70)	154.3 (2.20)	159.1 (1.90)
Sm	60.6 (0.97)	58.9 (0.85)	61.0 (0.89)	62.4 (0.87)	64.5 (0.85)
Eu	4.38 (0.10)	4.25 (0.08)	4.44 (0.08)	4.68 (0.09)	4.69 (0.11)
Gd	72.5 (0.96)	71.4 (0.96)	74.0 (1.00)	75.7 (1.20)	76.0 (0.98)
Tb	9.4 (0.13)	9.3 (0.13)	9.5 (0.16)	9.7 (0.15)	9.9 (0.14)
Dy	53.8 (0.89)	52.5 (0.68)	54.2 (0.73)	54.5 (0.87)	55.9 (0.68)
Ho	10.1 (0.17)	9.8 (0.14)	10.1 (0.14)	10.1 (0.17)	10.6 (0.12)
Er	24.1 (0.34)	23.6 (0.35)	24.1 (0.31)	24.6 (0.42)	25.4 (0.38)
Tm	2.6 (0.05)	2.6 (0.05)	2.6 (0.04)	2.7 (0.05)	2.7 (0.05)
Yb	12.6 (0.24)	12.5 (0.23)	13.1 (0.25)	13.0 (0.25)	13.6 (0.26)
Lu	1.8 (0.04)	1.7 (0.04)	1.8 (0.04)	1.8 (0.05)	1.9 (0.05)
∑REE + Y	730.1 (2.6)	717.0 (2.5)	747.6 (2.5)	766.3 (3.1)	785.7 (2.7)
$(La/Lu)_{CN}$	1.01 (0.18)	1.00 (0.19)	1.05 (0.20)	1.04 (0.21)	1.01 (0.19)
$(La/Sm)_{CN}$	0.18 (0.03)	0.18 (0.03)	0.19 (0.03)	0.19 (0.03)	0.18 (0.03)
$(La/Y)_{CN}$	0.53 (0.08)	0.53 (0.08)	0.54 (0.08)	0.55 (0.09)	0.55 (0.08)
Eu_A = Eu/Eu*	0.20 (0.01)	0.20 (0.01)	0.20 (0.01)	0.21 (0.01)	0.20 (0.01)
Ce_A = Ce/Ce*	0.92 (0.04)	0.93 (0.04)	0.94 (0.04)	0.95 (0.05)	0.94 (0.04)

TABLE C15. A.M. Berges W-Prospect, Mexico (CMNMC 40278).

Sample (ppm)	CMNMC40278 _A_1	CMNMC40278 _A_2	CMNMC40278 _A_3	CMNMC40278 _A_4	CMNMC40278 _A_5	CMNMC40278 _A_6	CMNMC40278 _A_7	CMNMC40278_ A_8	CMNMC40278_ A_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (3.5)	13 (27.0)	11 (15.0)	≤ LOD	≤ LOD
B	21 (3.0)	28 (4.5)	29 (3.5)	24 (3.6)	24 (2.6)	28 (5.4)	25 (3.5)	26 (5.9)	25 (3.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	7 (12.0)	≤ LOD	≤ LOD	4 (11.0)	6 (21.0)	10 (15.0)	≤ LOD	≤ LOD
V	≤ LOD	3 (2.4)	2 (1.8)	4 (2.2)	2 (1.3)	5 (7.9)	8 (1.8)	4 (1.1)	4 (1.4)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.7 (1.9)	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	3 (4.3)	6 (5.8)	4 (2.2)	6 (6.5)	4 (4.4)	6 (2.1)	4 (1.8)
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (4.2)	≤ LOD
As	49 (12.0)	25 (10.0)	30 (11.0)	28 (6.4)	31 (7.4)	44 (23.0)	47 (17.0)	40 (16.0)	56 (16.0)
Rb	≤ LOD	0.7 (0.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	654.0 (73.0)	840.0 (160.0)	954.0 (86.0)	700.0 (120.0)	649.0 (71.0)	730.0 (320.0)	640.0 (89.0)	810.0 (200.0)	770.0 (130.0)
Y	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	41100 (5000.0)	47600 (6300.0)	40400 (4300.0)	34800 (6500.0)	19000 (2600.0)	28700 (8400.0)	17000 (3000.0)	17700 (6400.0)	10300 (2000.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.0 (1.1)	0.6 (1.3)	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	667000 (73000)	800000 (200000)	754000 (98000)	680000 (100000)	770000 (88000)	970000 (250000)	810000 (130000)	840000 (250000)	870000 (140000)
La	0.4 (0.10)	0.5 (0.26)	0.6 (0.22)	0.7 (0.25)	1.1 (0.19)	0.8 (0.49)	0.8 (0.25)	1.3 (0.25)	1.7 (0.37)
Ce	0.6 (0.13)	1.4 (0.49)	0.6 (0.21)	0.8 (0.41)	1.9 (0.25)	1.7 (0.80)	1.8 (0.22)	2.2 (0.61)	2.9 (0.42)
Pr	≤ LOD	0.1 (0.10)	≤ LOD	≤ LOD	0.2 (0.07)	0.3 (0.13)	0.2 (0.12)	0.3 (0.14)	0.3 (0.11)
Nd	≤ LOD	0.8 (0.52)	0.5 (0.36)	≤ LOD	0.9 (0.28)	≤ LOD	0.9 (0.78)	1.6 (0.76)	1.3 (0.40)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.12 (0.10)	≤ LOD
Gd	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.26)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	1.4 (2.8)	3.0 (2.8)	2.1 (2.9)	1.8 (3.0)	4.6 (2.1)	3.2 (3.0)	3.9 (3.0)	5.8 (3.0)	7.4 (2.4)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	4.55 (7.14)	6.91 (10.84)	n.d.	n.d.	24.64 (36.56)	n.d.	n.d.	n.d.	3.47 (3.51)
$(La/Y)_{CN}$	29.42 (32.81)	27.61 (36.95)	27.92 (33.24)	147.03 (235.38)	46.20 (39.95)	n.d.	n.d.	25.02 (25.63)	28.29 (23.42)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	0.54 (1.70)	n.d.	n.d.	n.d.	0.23 (0.42)
$Ce_A = Ce/Ce^*$	0.91 (0.51)	1.16 (1.03)	0.48 (0.39)	0.72 (0.59)	0.97 (0.35)	0.93 (0.87)	1.03 (0.63)	0.82 (0.42)	0.94 (0.39)

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TABLE C15. *(continued)*

Sample (ppm)	CMNMC40278 _A_11	CMNMC40278 _A_13	CMNMC40278 _A_14	CMNMC40278 _A_15	CMNMC40278 _A_16	CMNMC40278 _A_17	CMNMC40278 _A_18	CMNMC40278_ A_19	CMNMC40278_ A_20
Li	≤ LOD	≤ LOD	6 (8.3)	≤ LOD	≤ LOD	≤ LOD	8 (11.0)	≤ LOD	10 (8.1)
B	28 (3.7)	23 (6.3)	25 (2.1)	26 (1.5)	24 (3.2)	26 (1.3)	29 (2.5)	26 (2.7)	25 (2.3)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	8 (11.0)	2 (14.0)	6 (19.0)	10 (25.0)	10 (8.2)	≤ LOD	≤ LOD	6 (13.0)
V	7 (1.7)	6 (5.4)	5 (2.2)	5 (1.6)	7 (2.3)	7 (1.3)	7 (2.2)	7 (1.9)	7 (1.6)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (8.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	37 (20.0)	24 (16.0)	5 (6.0)	3 (2.3)	4 (3.3)	8 (2.5)	800 (1000.0)	180 (170.0)	49 (41.0)
Zn	≤ LOD	≤ LOD	2 (2.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.9)	≤ LOD
As	13 (4.6)	11 (9.1)	8 (4.2)	16 (5.1)	17 (4.6)	61 (14.0)	28 (6.8)	16 (6.8)	65 (17.0)
Rb	≤ LOD	≤ LOD	≤ LOD	0.9 (0.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	810.0 (140.0)	1270.0 (420.0)	1480.0 (150.0)	3990.0 (830.0)	2580.0 (650.0)	860.0 (100.0)	3130.0 (630.0)	1810.0 (320.0)	793.0 (65.0)
Y	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	10600 (4800.0)	4900 (1200.0)	57200 (7300.0)	31000 (6500.0)	65500 (2700.0)	90700 (6100.0)	21500 (7700.0)	44700 (9200.0)	98000 (7800.0)
Ag	11 (6.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	40 (39.0)	3 (2.3)
Sn	≤ LOD	0.5 (1.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	850000 (140000)	880000 (280000)	687000 (48000)	825000 (83000)	704000 (94000)	688000 (47000)	928000 (83000)	780000 (150000)	687000 (62000)
La	1.3 (0.52)	0.6 (0.23)	2.3 (0.69)	4.1 (0.88)	0.8 (0.29)	≤ LOD	3.3 (0.90)	1.3 (0.29)	≤ LOD
Ce	2.7 (1.00)	0.9 (0.46)	4.3 (1.60)	3.4 (0.61)	0.7 (0.34)	0.2 (0.05)	2.7 (0.54)	1.2 (0.23)	0.1 (0.07)
Pr	0.2 (0.13)	≤ LOD	0.3 (0.11)	0.3 (0.15)	0.2 (0.08)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Nd	1.3 (0.60)	≤ LOD	1.5 (0.74)	0.9 (0.70)	0.7 (0.58)	≤ LOD	0.7 (0.33)	≤ LOD	≤ LOD
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.2 (0.28)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	5.9 (3.0)	2.3 (2.9)	8.7 (3.1)	9.2 (3.0)	2.6 (2.9)	0.3 (3.2)	7.1 (3.0)	3.0 (2.7)	0.3 (3.0)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	n.d.	n.d.	11.28 (14.28)	5.67 (5.46)	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Y)_{CN}$	337.66 (562.99)	15.85 (15.44)	119.64 (140.23)	386.46 (491.89)	n.d.	n.d.	90.84 (91.99)	240.02 (315.74)	n.d.
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	1.22 (1.00)	1.06 (0.95)	1.10 (0.68)	0.55 (0.24)	0.43 (0.31)	1.32 (1.31)	0.59 (0.33)	0.60 (0.28)	1.33 (1.85)

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TABLE C15. *(continued)*

Sample (ppm)	CMNMC40278 _A_21	CMNMC40278 _A_22	CMNMC40278 _B_1	CMNMC40278 _B_2	CMNMC40278 _B_3	CMNMC40278 _B_4	CMNMC40278 _B_5	CMNMC40278_ B_6	CMNMC40278_ B_7
Li	≤ LOD	≤ LOD	5 (2.8)	≤ LOD	13 (17.0)	≤ LOD	≤ LOD	4 (7.5)	≤ LOD
B	26 (2.0)	25 (2.8)	25 (1.4)	24 (4.3)	29 (3.4)	26 (8.2)	27 (5.2)	28 (3.4)	29 (2.4)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	46 (75.0)	≤ LOD	110 (210.0)	170 (83.0)	≤ LOD	35 (57.0)	180 (310.0)
Ti	22 (27.0)	≤ LOD	7 (6.0)	3 (12.0)	≤ LOD	5 (21.0)	≤ LOD	11 (21.0)	16 (31.0)
V	6 (3.7)	5 (1.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	0.9 (0.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	5 (7.5)	2 (3.4)	2 (2.1)	≤ LOD	≤ LOD	3 (9.1)	2 (10.0)	≤ LOD	≤ LOD
Cu	5 (3.8)	74 (60.0)	≤ LOD	≤ LOD	≤ LOD	4 (4.3)	≤ LOD	2 (3.3)	≤ LOD
Zn	2 (4.0)	3 (2.8)	≤ LOD	2 (1.9)	2 (4.3)	≤ LOD	8 (12.0)	≤ LOD	6 (3.6)
As	24 (8.3)	28 (6.3)	47 (6.1)	18 (13.0)	40 (22.0)	26 (15.0)	14 (9.6)	15 (6.6)	5 (3.9)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	1220.0 (360.0)	2690.0 (460.0)	753.0 (45.0)	335.0 (89.0)	910.0 (250.0)	980.0 (540.0)	1020.0 (230.0)	1360.0 (360.0)	436.0 (33.0)
Y	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.4)	0.8 (0.3)	≤ LOD	≤ LOD	0.7 (0.5)
Mo	93000 (17000.0)	13900 (4700.0)	93300 (5100.0)	37500 (7600.0)	68000 (32000.0)	9600 (2800.0)	56000 (22000.0)	8600 (2700.0)	1360 (63.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	1.0 (0.9)	0.6 (0.4)	≤ LOD	≤ LOD	≤ LOD	0.6 (1.3)	0.5 (1.3)	≤ LOD	1.1 (0.8)
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	730000 (130000)	940000 (120000)	711000 (48000)	660000 (120000)	970000 (140000)	810000 (280000)	700000 (150000)	820000 (170000)	960000 (150000)
La	0.3 (0.21)	1.3 (0.29)	≤ LOD	0.4 (0.26)	1.1 (0.95)	4.6 (1.70)	1.7 (0.66)	2.8 (1.20)	9.7 (2.70)
Ce	0.2 (0.13)	1.1 (0.27)	0.2 (0.03)	1.3 (0.53)	1.3 (1.00)	16.5 (9.30)	1.6 (0.38)	2.8 (2.10)	19.5 (6.10)
Pr	≤ LOD	≤ LOD	≤ LOD	0.2 (0.12)	≤ LOD	1.4 (0.60)	0.3 (0.31)	0.3 (0.27)	1.5 (0.38)
Nd	≤ LOD	≤ LOD	≤ LOD	1.0 (0.53)	1.0 (0.94)	8.0 (5.30)	≤ LOD	1.1 (0.64)	9.7 (5.50)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.7 (0.42)	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	0.26 (0.21)	≤ LOD	0.10 (0.10)	≤ LOD	0.12 (0.14)	0.41 (0.53)
Gd	≤ LOD	≤ LOD	≤ LOD	0.3 (0.25)	≤ LOD	0.4 (0.39)	≤ LOD	≤ LOD	≤ LOD
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.42)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	0.5 (3.2)	2.9 (2.7)	0.3 (3.0)	4.0 (2.2)	4.3 (3.1)	32.7 (11.1)	4.1 (3.2)	7.4 (3.7)	42.1 (9.0)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	n.d.	n.d.	n.d.	6.11 (9.96)	n.d.	4.06 (3.98)	n.d.	n.d.	n.d.
$(La/Y)_{CN}$	n.d.	50.83 (50.56)	6.79 (6.78)	9.17 (11.90)	16.12 (21.19)	40.77 (34.19)	n.d.	60.04 (58.38)	94.81 (94.78)
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	5.80 (11.10)	n.d.	0.53 (0.76)	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	0.47 (0.74)	0.53 (0.25)	2.14 (1.77)	1.01 (0.90)	0.70 (1.08)	1.53 (1.21)	0.52 (0.46)	0.62 (0.68)	1.11 (0.58)

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TABLE C15. *(continued)*

Sample (ppm)	CMNMC40278 _B_8	CMNMC40278 _B_9	CMNMC40278 _B_10	CMNMC40278 _B_11	CMNMC40278 _B_12	CMNMC40278 _B_13	CMNMC40278 _B_14	CMNMC40278_ B_15	CMNMC40278_ B_16
Li	15 (21.0)	≤ LOD	≤ LOD	13 (17.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (6.3)
B	30 (4.5)	28 (2.3)	28 (6.0)	26 (1.8)	29 (1.7)	35 (4.6)	27 (9.9)	23 (3.7)	25 (4.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	50 (150.0)	≤ LOD	≤ LOD	158 (97.0)	30 (140.0)	31 (75.0)	≤ LOD
Ti	≤ LOD	2 (19.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	28 (43.0)	≤ LOD	2 (18.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (4.2)	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6.0 (11.0)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	3 (8.5)	≤ LOD	97 (72.0)	≤ LOD	≤ LOD	≤ LOD
Co	1.3 (0.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3.8 (1.4)	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	7 (8.7)	≤ LOD	2 (5.9)	≤ LOD
Cu	≤ LOD	≤ LOD	9 (7.5)	51 (52.0)	≤ LOD	640 (410.0)	4 (1.5)	12 (14.0)	162 (85.0)
Zn	≤ LOD	3 (3.5)	≤ LOD	2 (4.2)	≤ LOD	2 (3.9)	≤ LOD	2 (2.2)	≤ LOD
As	15 (6.0)	14 (3.7)	26 (4.3)	37 (19.0)	8 (6.8)	720 (440.0)	18 (15.0)	43 (15.0)	25 (8.8)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	2000.0 (1200.0)	1850.0 (320.0)	3940.0 (790.0)	1240.0 (610.0)	550.0 (170.0)	474.0 (75.0)	403.0 (91.0)	750.0 (120.0)	2300.0 (720.0)
Y	0.5 (0.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.4)	1.0 (0.5)	≤ LOD	≤ LOD
Mo	17000 (5100.0)	8000 (1300.0)	8700 (1700.0)	56000 (21000.0)	780 (380.0)	160000 (97000.0)	2700 (1100.0)	87000 (15000.0)	18300 (8900.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	68 (32.0)	1 (1.6)	≤ LOD	≤ LOD
Sn	0.6 (0.7)	≤ LOD	1.4 (1.2)	≤ LOD	≤ LOD	0.6 (0.8)	0.9 (0.8)	0.7 (0.6)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	1030000 (220000)	810000 (120000)	930000 (200000)	820000 (240000)	1050000 (210000)	960000 (150000)	800000 (220000)	605000 (80000)	820000 (180000)
La	8.7 (2.30)	2.2 (0.97)	22.1 (5.60)	3.7 (4.00)	1.5 (0.68)	1.1 (0.27)	0.6 (0.52)	≤ LOD	2.9 (0.79)
Ce	12.7 (2.60)	1.7 (0.93)	20.5 (4.30)	3.4 (2.30)	3.1 (1.20)	2.3 (1.20)	1.4 (0.37)	0.5 (0.19)	2.0 (0.54)
Pr	1.3 (0.31)	0.1 (0.06)	1.9 (0.58)	0.2 (0.17)	0.3 (0.16)	0.4 (0.26)	0.3 (0.20)	≤ LOD	0.2 (0.10)
Nd	5.4 (1.00)	0.7 (0.33)	5.6 (2.20)	≤ LOD	0.9 (0.89)	0.9 (0.65)	1.0 (0.82)	≤ LOD	0.6 (0.29)
Sm	0.8 (0.41)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	0.16 (0.12)	≤ LOD	0.20 (0.16)	0.13 (0.15)	0.17 (0.16)	0.23 (0.20)	0.10 (0.20)	≤ LOD	≤ LOD
Gd	0.5 (0.65)	≤ LOD	≤ LOD	0.3 (0.35)	≤ LOD	≤ LOD	0.5 (0.67)	≤ LOD	≤ LOD
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.7 (0.50)	0.5 (0.81)	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	30.1 (4.3)	5.3 (3.0)	50.5 (7.9)	7.9 (5.3)	6.8 (2.6)	6.7 (2.9)	5.8 (2.6)	0.8 (3.0)	5.9 (2.8)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	7.08 (6.32)	n.d.	n.d.	n.d.	3.31 (4.11)	n.d.	n.d.	n.d.	n.d.
$(La/Y)_{CN}$	111.21 (128.82)	32.20 (33.27)	864.08 (1095.68)	n.d.	26.76 (30.36)	8.86 (7.75)	3.86 (4.52)	n.d.	162.29 (176.93)
Eu_A = Eu/Eu*	0.74 (1.01)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	0.81 (0.37)	0.51 (0.49)	0.59 (0.28)	0.63 (1.30)	1.05 (0.84)	0.83 (0.72)	0.84 (1.01)	0.96 (1.15)	0.45 (0.24)

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TABLE C15. *(continued)*

Sample (ppm)	CMNMC40278_B_17	CMNMC40278_B_18	CMNMC40278_B_19	CMNMC40278_B_20	CMNMC40278_B_21	CMNMC40278_B_22	CMNMC40278_B_23	CMNMC40278_B_24
Li	5 (10.0)	≤ LOD	≤ LOD	2 (2.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	31 (2.9)	25 (3.6)	28 (4.4)	27 (1.7)	29 (3.7)	27 (2.3)	29 (5.5)	22 (5.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	140 (63.0)	110 (120.0)	35 (34.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	14 (14.0)	≤ LOD	≤ LOD	6 (8.4)	15 (41.0)	10 (21.0)	≤ LOD	19 (15.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2.0)	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	11 (8.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (7.3)
Cu	5 (3.5)	320 (330.0)	≤ LOD	≤ LOD	8 (6.6)	≤ LOD	11 (15.0)	10 (12.0)
Zn	4 (1.9)	2 (2.6)	2 (4.5)	≤ LOD	3 (3.6)	4 (3.7)	≤ LOD	≤ LOD
As	≤ LOD	6 (4.9)	18 (6.3)	20 (3.0)	53 (32.0)	31 (11.0)	140 (110.0)	89 (59.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (0.6)
Sr	266.0 (47.0)	780.0 (270.0)	740.0 (160.0)	1065.0 (89.0)	1510.0 (410.0)	5200.0 (1600.0)	1080.0 (320.0)	1500.0 (580.0)
Y	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	6900 (2700.0)	56000 (11000.0)	25100 (7300.0)	5310 (540.0)	33000 (13000.0)	58000 (20000.0)	99500 (22000.0)	50000 (13000.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	0.7 (0.6)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.5)	1.7 (2.4)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	780000 (100000)	870000 (160000)	890000 (180000)	872000 (77000)	743000 (79000)	830000 (100000)	950000 (480000)	570000 (150000)
La	0.6 (0.18)	0.7 (0.39)	1.3 (0.40)	1.5 (0.22)	1.2 (0.53)	0.6 (0.18)	0.5 (0.17)	0.8 (0.63)
Ce	1.5 (0.64)	1.1 (0.32)	1.6 (0.44)	1.5 (0.22)	0.9 (0.34)	0.7 (0.29)	1.2 (0.66)	0.9 (0.58)
Pr	≤ LOD	0.1 (0.10)	≤ LOD	0.1 (0.04)	≤ LOD	≤ LOD	≤ LOD	0.2 (0.08)
Nd	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.2 (1.10)	≤ LOD
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	0.16 (0.10)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	2.5 (2.7)	2.6 (2.7)	4.3 (2.8)	3.8 (2.7)	2.3 (3.2)	1.9 (2.9)	3.0 (3.3)	2.4 (3.1)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	n.d.	1.70 (2.36)	2.45 (3.10)	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Y)_{CN}$	28.49 (34.24)	33.23 (43.06)	23.08 (24.49)	59.78 (44.52)	n.d.	25.26 (27.49)	30.58 (48.08)	n.d.
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.35 (1.11)	0.84 (0.81)	0.81 (0.57)	0.64 (0.19)	0.46 (0.38)	0.67 (0.49)	1.46 (1.89)	0.60 (0.75)

TABLE C16. Britannia Mine, BC, Canada (CMNMC 50171).

Sample (ppm)	CMNMC50171 _A_1	CMNMC50171 _A_2	CMNMC50171 _A_3	CMNMC50171 _A_4	CMNMC50171 _A_5	CMNMC50171 _A_6	CMNMC50171 _A_7	CMNMC50171_ A_8	CMNMC50171_ A_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	7 (7.7)	≤ LOD	≤ LOD	4 (8.6)	24 (49.0)
B	≤ LOD	39 (18.0)	49 (14.0)	45 (6.2)	46 (8.8)	54 (6.4)	52 (5.0)	53 (4.8)	39 (25.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	19 (19.0)	2 (7.2)	2 (8.6)	≤ LOD	≤ LOD	6 (17.0)	10 (34.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (41.0)
Mn	≤ LOD	3.0 (16.0)	13.0 (10.0)	6.0 (5.3)	≤ LOD	≤ LOD	2.1 (8.8)	8.0 (11.0)	15.0 (11.0)
Fe	≤ LOD	2 (37.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	71 (60.0)
Co	1.1 (0.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.5 (1.0)
Ni	2 (11.0)	6 (7.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (31.0)
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	4 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (20.0)
As	20 (5.3)	17 (7.5)	30 (9.4)	58 (6.3)	62 (7.1)	89 (15.0)	69 (7.5)	192 (36.0)	124 (23.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.0 (4.6)
Sr	95.0 (13.0)	97.0 (28.0)	90.0 (11.0)	83.0 (6.9)	92.0 (11.0)	83.1 (6.0)	69.8 (6.6)	84.0 (14.0)	86.0 (33.0)
Y	≤ LOD	≤ LOD	≤ LOD	1.3 (0.3)	1.7 (0.3)	2.0 (0.5)	2.7 (0.7)	3.8 (0.7)	7.5 (5.1)
Mo	5960 (650.0)	3740 (700.0)	8500 (1800.0)	5080 (370.0)	5550 (520.0)	7180 (800.0)	4700 (500.0)	21000 (3900.0)	5700 (2300.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	845000 (91000)	1070000 (230000)	990000 (150000)	838000 (68000)	1020000 (120000)	1000000 (120000)	866000 (54000)	940000 (120000)	850000 (170000)
La	8.3 (0.93)	7.5 (0.70)	14.4 (2.90)	37.6 (3.00)	39.7 (3.80)	40.5 (2.90)	33.6 (3.10)	81.1 (6.40)	57.6 (4.60)
Ce	29.8 (3.70)	27.7 (6.10)	46.3 (8.00)	106.0 (7.90)	113.9 (8.90)	116.0 (11.00)	92.5 (7.80)	219.0 (34.00)	142.0 (26.00)
Pr	5.4 (0.68)	5.2 (1.20)	6.8 (1.30)	13.1 (1.10)	13.8 (1.60)	14.0 (1.40)	12.2 (1.00)	27.0 (4.50)	23.2 (8.40)
Nd	18.2 (3.40)	14.3 (2.40)	22.2 (3.40)	38.4 (4.40)	41.9 (5.80)	42.6 (4.80)	40.5 (4.20)	79.0 (15.00)	77.0 (20.00)
Sm	1.5 (0.62)	1.4 (0.86)	0.9 (0.69)	1.7 (0.46)	2.7 (0.85)	2.5 (0.72)	1.9 (0.68)	4.4 (0.80)	10.4 (7.00)
Eu	0.17 (0.11)	≤ LOD	≤ LOD	0.26 (0.09)	0.27 (0.10)	0.18 (0.08)	0.19 (0.08)	0.44 (0.22)	1.10 (1.10)
Gd	≤ LOD	≤ LOD	0.4 (0.38)	0.9 (0.35)	1.3 (0.45)	1.2 (0.42)	1.3 (0.47)	1.6 (0.68)	7.8 (3.00)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.2 (0.08)	≤ LOD	0.6 (0.48)
Dy	≤ LOD	≤ LOD	≤ LOD	0.4 (0.14)	0.6 (0.22)	≤ LOD	0.7 (0.31)	0.8 (0.43)	2.8 (2.90)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (1.20)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	63.6 (5.7)	56.2 (7.2)	91.0 (9.5)	199.8 (9.8)	216.2 (11.6)	219.6 (12.6)	186.2 (9.6)	417.7 (38.0)	330.9 (35.2)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	3.58 (2.62)	3.29 (2.74)	10.14 (10.02)	13.94 (8.27)	9.28 (5.97)	10.15 (6.09)	10.86 (7.22)	11.50 (5.86)	3.47 (3.01)
$(La/Y)_{CN}$	241.02 (233.52)	498.51 (589.00)	n.d.	195.25 (105.31)	157.07 (85.78)	135.27 (77.48)	83.02 (49.56)	141.86 (70.93)	51.05 (44.50)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	0.32 (0.60)	0.57 (0.32)	0.39 (0.24)	0.28 (0.17)	0.34 (0.22)	0.41 (0.25)	0.36 (0.48)
$Ce_A = Ce/Ce^*$	1.03 (0.23)	1.02 (0.38)	1.12 (0.37)	1.14 (0.16)	1.17 (0.20)	1.17 (0.18)	1.10 (0.17)	1.12 (0.27)	0.93 (0.39)

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TABLE C16. *(continued)*

Sample (ppm)	CMNMC50171 _A_10	CMNMC50171 _A_11	CMNMC50171 _A_12	CMNMC50171 _A_13	CMNMC50171 _A_14	CMNMC50171 _B_1	CMNMC50171 _B_2	CMNMC50171_ B_3	CMNMC50171_ B_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (12.0)	≤ LOD	≤ LOD	16 (15.0)
B	51 (5.1)	42 (5.9)	40 (3.6)	44 (6.7)	35 (12.0)	34 (11.0)	41 (4.7)	42 (6.9)	46 (5.2)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	4 (8.9)	3 (7.7)	≤ LOD	5 (13.0)	15 (16.0)	≤ LOD	≤ LOD	11 (12.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	2.6 (6.5)	≤ LOD	≤ LOD	≤ LOD	6.0 (14.0)	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	4 (12.0)	≤ LOD	≤ LOD	≤ LOD	140 (220.0)	≤ LOD	≤ LOD	≤ LOD
Co	0.8 (1.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	3 (7.6)	6 (8.8)	10 (10.0)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	2 (2.2)	≤ LOD	6 (7.6)	≤ LOD	≤ LOD	2 (2.7)
Zn	≤ LOD	3 (1.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (2.8)
As	367 (74.0)	142 (13.0)	135 (15.0)	168 (17.0)	330 (60.0)	≤ LOD	≤ LOD	≤ LOD	5 (2.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	85.2 (9.2)	77.1 (6.2)	74.4 (7.6)	80.1 (9.4)	78.6 (8.8)	96.0 (8.4)	92.2 (5.2)	83.9 (5.1)	124.0 (7.4)
Y	2.0 (0.8)	≤ LOD	≤ LOD	0.5 (0.2)	2.0 (0.8)	≤ LOD	≤ LOD	≤ LOD	1.1 (0.4)
Mo	25900 (3100.0)	13400 (1100.0)	14800 (1300.0)	16800 (1700.0)	11400 (1500.0)	3150 (260.0)	3480 (240.0)	4510 (380.0)	3640 (350.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2.5)	≤ LOD	≤ LOD	≤ LOD
W	920000 (120000)	955000 (93000)	809000 (78000)	890000 (110000)	890000 (170000)	909000 (63000)	971000 (54000)	896000 (59000)	878000 (59000)
La	118.0 (22.00)	59.0 (4.30)	56.9 (4.50)	71.4 (5.10)	117.0 (19.00)	≤ LOD	0.3 (0.11)	0.3 (0.14)	3.3 (0.85)
Ce	319.0 (71.00)	151.0 (12.00)	164.0 (14.00)	194.0 (16.00)	291.0 (55.00)	1.3 (1.30)	1.7 (0.38)	3.4 (0.97)	13.9 (3.10)
Pr	37.7 (5.50)	16.1 (1.50)	17.5 (1.70)	21.9 (2.00)	30.2 (4.70)	0.2 (0.15)	0.3 (0.09)	0.7 (0.34)	2.5 (0.55)
Nd	109.0 (21.00)	40.6 (3.60)	43.0 (4.30)	60.4 (6.10)	93.0 (17.00)	1.5 (0.83)	1.8 (0.45)	4.2 (1.10)	11.4 (2.60)
Sm	3.8 (1.10)	1.4 (0.42)	1.3 (0.38)	2.5 (0.72)	3.7 (1.30)	≤ LOD	≤ LOD	1.0 (0.51)	1.2 (0.57)
Eu	0.72 (0.28)	0.12 (0.06)	0.13 (0.07)	0.29 (0.12)	0.31 (0.14)	0.11 (0.08)	≤ LOD	0.14 (0.10)	0.45 (0.16)
Gd	1.7 (0.83)	0.9 (0.37)	0.7 (0.31)	1.2 (0.45)	1.6 (0.46)	0.3 (0.29)	0.5 (0.20)	0.4 (0.30)	0.5 (0.29)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.2 (0.10)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.8 (0.35)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.25)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	593.0 (77.5)	269.5 (13.5)	283.9 (15.5)	352.3 (18.1)	539.8 (60.8)	4.0 (2.7)	5.0 (2.1)	10.6 (2.6)	35.1 (4.4)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	19.46 (13.43)	26.80 (16.46)	27.43 (16.72)	17.83 (10.67)	19.82 (14.21)	n.d.	0.88 (0.94)	0.16 (0.17)	1.75 (1.51)
$(La/Y)_{CN}$	384.47 (292.48)	1005.54 (661.32)	1454.62 (991.62)	1009.75 (727.30)	394.76 (293.66)	8.55 (12.68)	11.35 (10.99)	5.08 (5.18)	19.94 (15.13)
$Eu_A = Eu/Eu^*$	0.75 (0.47)	0.30 (0.21)	0.37 (0.28)	0.45 (0.28)	0.34 (0.24)	n.d.	0.66 (0.64)	0.55 (0.62)	1.56 (1.37)
$Ce_A = Ce/Ce^*$	1.14 (0.38)	1.16 (0.17)	1.24 (0.19)	1.17 (0.17)	1.15 (0.35)	1.38 (2.15)	1.17 (0.64)	1.23 (1.11)	1.11 (0.46)

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TABLE C16. *(continued)*

Sample (ppm)	CMNMC50171 _B_5	CMNMC50171 _B_6	CMNMC50171 _B_7	CMNMC50171 _B_8	CMNMC50171 _B_9	CMNMC50171 _B_10	CMNMC50171 _B_5	CMNMC50171_ B_6	CMNMC50171_ B_7
Li	2 (4.0)	1 (2.9)	2 (4.8)	≤ LOD	≤ LOD	≤ LOD	2 (4.0)	1 (2.9)	2 (4.8)
B	45 (3.7)	47 (3.3)	50 (4.4)	44 (5.7)	46 (4.9)	35 (9.1)	45 (3.7)	47 (3.3)	50 (4.4)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	26 (21.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	26 (21.0)	≤ LOD	≤ LOD
Ti	≤ LOD	3 (7.9)	11 (14.0)	14 (13.0)	≤ LOD	5 (12.0)	≤ LOD	3 (7.9)	11 (14.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	46 (52.0)	33 (84.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	46 (52.0)	33 (84.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	5 (7.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	3 (2.4)	≤ LOD	≤ LOD	3 (4.0)	2 (1.9)	≤ LOD	3 (2.4)	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	2 (2.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	58 (7.1)	31 (4.0)	30 (4.3)	21 (4.0)	23 (5.3)	9 (2.6)	58 (7.1)	31 (4.0)	30 (4.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	93.9 (7.4)	88.1 (6.0)	83.4 (5.2)	82.4 (7.6)	105.0 (24.0)	229.0 (17.0)	93.9 (7.4)	88.1 (6.0)	83.4 (5.2)
Y	2.1 (0.5)	0.7 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2.1 (0.5)	0.7 (0.2)	≤ LOD
Mo	5700 (360.0)	6640 (450.0)	5820 (330.0)	6210 (770.0)	4690 (440.0)	3600 (310.0)	5700 (360.0)	6640 (450.0)	5820 (330.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	893000 (51000)	877000 (47000)	942000 (50000)	904000 (63000)	790000 (130000)	878000 (80000)	893000 (51000)	877000 (47000)	942000 (50000)
La	35.8 (2.90)	13.1 (1.60)	13.0 (1.00)	10.3 (1.10)	6.9 (1.80)	2.7 (0.43)	35.8 (2.90)	13.1 (1.60)	13.0 (1.00)
Ce	103.2 (6.90)	46.8 (5.40)	38.3 (2.90)	35.8 (4.20)	26.5 (6.50)	11.5 (1.50)	103.2 (6.90)	46.8 (5.40)	38.3 (2.90)
Pr	12.4 (1.20)	6.8 (0.73)	5.6 (0.51)	6.0 (0.68)	4.9 (1.20)	2.3 (0.42)	12.4 (1.20)	6.8 (0.73)	5.6 (0.51)
Nd	34.7 (3.10)	21.7 (2.60)	23.4 (2.20)	21.8 (2.70)	17.3 (5.10)	9.0 (1.50)	34.7 (3.10)	21.7 (2.60)	23.4 (2.20)
Sm	1.9 (0.61)	1.1 (0.31)	1.1 (0.43)	≤ LOD	1.3 (0.60)	0.6 (0.39)	1.9 (0.61)	1.1 (0.31)	1.1 (0.43)
Eu	0.23 (0.09)	0.22 (0.07)	0.14 (0.07)	0.17 (0.09)	0.19 (0.16)	0.12 (0.08)	0.23 (0.09)	0.22 (0.07)	0.14 (0.07)
Gd	1.1 (0.42)	0.4 (0.19)	0.7 (0.27)	0.2 (0.20)	0.6 (0.51)	≤ LOD	1.1 (0.42)	0.4 (0.19)	0.7 (0.27)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.7 (0.29)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.7 (0.29)	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	192.6 (8.3)	91.0 (6.4)	82.4 (4.3)	74.9 (5.5)	58.2 (8.8)	26.6 (3.2)	192.6 (8.3)	91.0 (6.4)	82.4 (4.3)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	12.00 (7.66)	7.67 (4.92)	7.61 (5.27)	15.37 (13.10)	3.33 (2.83)	2.63 (2.31)	12.00 (7.66)	7.67 (4.92)	7.61 (5.27)
$(La/Y)_{CN}$	113.85 (62.98)	131.93 (91.99)	540.05 (452.99)	489.01 (443.62)	131.04 (145.51)	52.59 (37.69)	113.85 (62.98)	131.93 (91.99)	540.05 (452.99)
$Eu_A = Eu/Eu^*$	0.44 (0.29)	0.84 (0.50)	0.47 (0.36)	1.50 (1.71)	0.57 (0.67)	n.d.	0.44 (0.29)	0.84 (0.50)	0.47 (0.36)
$Ce_A = Ce/Ce^*$	1.17 (0.17)	1.17 (0.24)	1.08 (0.16)	1.07 (0.22)	1.04 (0.46)	1.03 (0.31)	1.17 (0.17)	1.17 (0.24)	1.08 (0.16)

TABLE C17. Ortiz Mine, New Mexico, USA (CMNMC 52204).

Sample (ppm)	CMNMC52204_A_1	CMNMC52204_A_2	CMNMC52204_A_3	CMNMC52204_A_4	CMNMC52204_A_5	CMNMC52204_A_6	CMNMC52204_A_7	CMNMC52204_A_8	CMNMC52204_A_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	11 (12.0)	9 (13.0)
B	31 (8.0)	42 (3.8)	37 (6.1)	42 (4.9)	41 (3.8)	42 (3.7)	40 (4.2)	37 (2.8)	38 (2.3)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	3 (13.0)	≤ LOD	≤ LOD	≤ LOD	5 (13.0)	23 (21.0)	4 (15.0)	4 (15.0)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (12.0)	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	3.6 (9.2)	≤ LOD	≤ LOD	≤ LOD	1.1 (7.6)	≤ LOD	4.3 (8.8)	1.3 (8.0)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (2.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	64 (10.0)	84 (14.0)	109 (12.0)	99 (12.0)	50 (8.1)	37 (7.6)	25 (6.2)	27 (4.4)	32 (6.5)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	182.0 (20.0)	199.0 (15.0)	206.0 (15.0)	208.0 (16.0)	210.0 (15.0)	205.0 (17.0)	222.0 (23.0)	209.0 (13.0)	183.0 (16.0)
Y	517.0 (56.0)	390.0 (57.0)	241.0 (23.0)	188.0 (13.0)	388.0 (30.0)	361.0 (23.0)	305.0 (29.0)	410.0 (41.0)	470.0 (42.0)
Mo	4180 (380.0)	4440 (370.0)	4030 (300.0)	4360 (350.0)	4540 (320.0)	4410 (410.0)	3830 (360.0)	3450 (210.0)	3210 (260.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	874000 (87000)	883000 (67000)	890000 (100000)	891000 (67000)	933000 (64000)	946000 (73000)	940000 (110000)	915000 (62000)	850000 (64000)
La	8.9 (1.10)	6.7 (1.20)	4.5 (0.70)	5.0 (0.60)	15.1 (1.40)	16.7 (1.60)	18.0 (1.90)	18.9 (3.10)	12.8 (1.10)
Ce	38.4 (4.00)	29.2 (4.40)	18.4 (2.00)	18.6 (1.60)	54.7 (3.40)	62.2 (4.10)	55.3 (4.70)	67.6 (7.20)	52.1 (3.20)
Pr	11.2 (1.40)	8.2 (1.50)	5.6 (0.61)	5.0 (0.49)	13.7 (1.00)	15.0 (1.30)	16.1 (1.90)	16.3 (1.50)	15.0 (1.40)
Nd	97.0 (11.00)	71.0 (11.00)	39.5 (5.70)	37.4 (3.40)	112.4 (7.40)	121.5 (8.90)	117.0 (14.00)	141.5 (9.00)	138.0 (13.00)
Sm	64.6 (5.40)	49.9 (8.00)	25.5 (3.90)	23.4 (2.60)	58.5 (3.80)	60.1 (6.10)	56.8 (7.10)	72.2 (5.80)	80.0 (6.30)
Eu	30.60 (3.20)	22.30 (3.40)	11.67 (0.89)	11.80 (1.20)	34.10 (2.00)	37.60 (2.50)	46.60 (4.50)	38.30 (2.60)	43.20 (2.60)
Gd	119.0 (12.00)	94.0 (16.00)	53.7 (5.70)	40.3 (4.00)	97.2 (7.10)	99.8 (8.90)	80.1 (7.50)	119.0 (12.00)	130.0 (12.00)
Tb	19.6 (1.80)	14.2 (2.10)	7.9 (0.99)	6.6 (0.76)	13.5 (0.96)	13.2 (0.99)	10.7 (1.80)	14.5 (1.50)	17.4 (1.70)
Dy	113.0 (12.00)	89.0 (14.00)	53.8 (5.80)	44.1 (4.20)	83.4 (7.30)	79.5 (6.60)	62.2 (6.90)	87.2 (8.80)	109.3 (8.30)
Ho	21.4 (2.20)	17.3 (2.20)	10.4 (1.20)	8.2 (0.77)	17.9 (1.30)	15.1 (1.10)	12.7 (1.30)	18.2 (2.00)	21.2 (1.70)
Er	57.4 (6.10)	41.0 (5.80)	26.1 (2.60)	21.6 (2.60)	40.9 (3.10)	39.2 (2.90)	33.9 (3.60)	46.6 (5.50)	53.3 (5.60)
Tm	5.5 (0.68)	4.4 (0.66)	3.0 (0.42)	2.1 (0.31)	4.4 (0.40)	4.2 (0.50)	3.5 (0.36)	4.8 (0.59)	5.1 (0.54)
Yb	32.1 (3.80)	20.3 (3.10)	14.5 (2.00)	11.3 (1.50)	23.8 (1.80)	20.7 (2.30)	16.4 (1.70)	26.6 (3.00)	31.4 (3.10)
Lu	4.0 (0.46)	3.2 (0.52)	2.0 (0.38)	1.9 (0.34)	3.4 (0.34)	3.8 (0.37)	3.2 (0.58)	3.6 (0.35)	4.1 (0.43)
∑REE + Y	1139.7 (23.0)	860.6 (26.9)	517.5 (11.5)	425.2 (8.2)	960.9 (14.4)	949.6 (16.8)	837.5 (20.5)	1085.3 (21.3)	1182.9 (22.1)
$(La/Lu)_{CN}$	0.23 (0.11)	0.22 (0.13)	0.23 (0.14)	0.28 (0.15)	0.47 (0.21)	0.46 (0.20)	0.58 (0.31)	0.55 (0.28)	0.32 (0.14)
$(La/Sm)_{CN}$	0.09 (0.04)	0.08 (0.05)	0.11 (0.06)	0.13 (0.06)	0.16 (0.06)	0.17 (0.08)	0.20 (0.10)	0.16 (0.08)	0.10 (0.04)
$(La/Y)_{CN}$	0.11 (0.06)	0.11 (0.07)	0.12 (0.06)	0.18 (0.08)	0.26 (0.11)	0.31 (0.12)	0.39 (0.18)	0.31 (0.16)	0.18 (0.08)
$Eu_A = Eu/Eu^*$	1.05 (0.18)	0.97 (0.28)	0.93 (0.18)	1.16 (0.21)	1.37 (0.16)	1.47 (0.22)	2.10 (0.39)	1.25 (0.19)	1.28 (0.18)
$Ce_A = Ce/Ce^*$	0.78 (0.18)	0.80 (0.27)	0.75 (0.16)	0.79 (0.15)	0.83 (0.11)	0.86 (0.13)	0.71 (0.14)	0.85 (0.17)	0.78 (0.13)

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TABLE C17. *(continued)*

Sample (ppm)	CMNMC52204 _A_10	CMNMC52204 _A_11	CMNMC52204 _B_1	CMNMC52204 _B_2	CMNMC52204 _B_3	CMNMC52204 _B_4	CMNMC52204 _B_5	CMNMC52204_ B_6	CMNMC52204_ B_7
Li	≤ LOD	≤ LOD	11 (12.0)	6 (7.7)	3 (6.3)	≤ LOD	18 (15.0)	5 (6.4)	≤ LOD
B	31 (3.9)	33 (3.8)	27 (4.3)	30 (2.8)	25 (3.5)	31 (1.8)	30 (3.6)	27 (2.7)	29 (2.2)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	7 (14.0)	5 (15.0)	≤ LOD	10 (15.0)	4 (14.0)	6 (15.0)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	2 (12.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	2.9 (7.2)	≤ LOD	≤ LOD	4.9 (5.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.1 (8.1)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	3 (6.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (1.9)
As	24 (4.0)	24 (2.6)	38 (6.1)	39 (5.1)	34 (5.4)	42 (5.8)	39 (6.4)	41 (5.3)	27 (5.4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	187.6 (9.9)	168.0 (12.0)	215.0 (16.0)	201.0 (15.0)	187.0 (10.0)	199.0 (10.0)	201.0 (14.0)	195.0 (13.0)	218.0 (14.0)
Y	321.0 (21.0)	304.0 (21.0)	372.0 (23.0)	309.0 (31.0)	280.0 (17.0)	310.0 (23.0)	307.0 (28.0)	253.0 (13.0)	235.0 (18.0)
Mo	3460 (130.0)	3560 (270.0)	4350 (280.0)	4340 (310.0)	4190 (260.0)	4400 (210.0)	4530 (250.0)	4460 (220.0)	3920 (230.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	854000 (58000)	900000 (69000)	853000 (56000)	895000 (54000)	915000 (64000)	957000 (63000)	932000 (69000)	877000 (48000)	932000 (74000)
La	17.1 (1.10)	12.7 (1.40)	12.5 (1.10)	15.0 (1.60)	15.0 (1.20)	15.5 (1.20)	16.3 (1.60)	14.7 (0.83)	18.8 (1.50)
Ce	63.7 (3.10)	54.6 (4.20)	51.4 (3.10)	50.1 (4.00)	49.0 (2.60)	49.7 (3.00)	53.2 (4.40)	48.9 (3.60)	57.7 (5.20)
Pr	16.0 (0.96)	14.7 (1.00)	12.1 (1.00)	12.3 (1.20)	12.2 (1.00)	12.7 (1.10)	12.6 (1.10)	11.9 (0.87)	13.2 (1.30)
Nd	137.2 (8.50)	128.3 (8.40)	105.0 (12.00)	94.8 (7.50)	95.0 (5.60)	101.5 (6.30)	102.6 (8.50)	93.7 (8.60)	102.0 (7.20)
Sm	74.3 (6.00)	74.1 (5.50)	56.0 (5.00)	48.3 (5.00)	52.8 (4.40)	52.5 (5.40)	54.7 (4.60)	44.7 (4.00)	44.5 (5.10)
Eu	42.80 (3.90)	39.80 (2.80)	30.80 (3.50)	29.60 (3.10)	29.30 (2.00)	28.90 (2.20)	30.80 (2.70)	27.40 (1.70)	42.60 (2.80)
Gd	110.8 (7.40)	112.8 (9.10)	86.7 (6.10)	80.6 (5.80)	79.6 (5.80)	81.4 (5.50)	78.6 (8.40)	66.3 (4.40)	66.3 (5.40)
Tb	12.8 (0.85)	13.9 (1.40)	12.9 (1.50)	10.3 (0.92)	9.8 (0.66)	10.2 (0.85)	10.3 (1.30)	8.9 (0.62)	8.6 (0.95)
Dy	65.8 (4.50)	80.5 (6.50)	77.2 (5.90)	68.0 (6.00)	61.4 (3.50)	69.9 (5.10)	66.4 (5.80)	53.7 (3.30)	54.8 (7.70)
Ho	15.3 (1.40)	15.6 (1.30)	15.4 (1.00)	13.5 (0.94)	12.8 (0.92)	13.8 (1.50)	13.0 (1.00)	10.6 (0.73)	11.7 (1.30)
Er	36.4 (3.10)	36.7 (3.30)	38.9 (3.60)	36.5 (3.50)	31.8 (2.20)	32.0 (2.00)	31.7 (3.10)	26.2 (1.70)	28.5 (3.60)
Tm	4.0 (0.43)	3.3 (0.35)	4.1 (0.44)	3.8 (0.34)	3.2 (0.41)	3.5 (0.42)	3.4 (0.35)	3.0 (0.27)	3.3 (0.32)
Yb	19.4 (1.50)	14.8 (1.60)	22.8 (2.00)	18.3 (1.50)	19.3 (2.00)	18.9 (2.60)	17.7 (1.10)	15.1 (1.40)	18.5 (1.40)
Lu	2.6 (0.26)	2.3 (0.22)	3.5 (0.52)	3.0 (0.32)	3.0 (0.28)	3.0 (0.31)	2.9 (0.36)	2.5 (0.20)	2.9 (0.41)
∑REE + Y	939.3 (15.0)	908.0 (16.5)	901.2 (16.9)	793.0 (14.0)	754.1 (11.0)	803.5 (12.5)	801.1 (15.5)	680.6 (12.0)	708.4 (14.9)
$(La/Lu)_{CN}$	0.68 (0.28)	0.58 (0.26)	0.38 (0.18)	0.52 (0.24)	0.52 (0.22)	0.54 (0.23)	0.59 (0.28)	0.62 (0.23)	0.67 (0.31)
$(La/Sm)_{CN}$	0.14 (0.05)	0.11 (0.05)	0.14 (0.06)	0.19 (0.09)	0.18 (0.07)	0.19 (0.08)	0.19 (0.08)	0.21 (0.08)	0.26 (0.12)
$(La/Y)_{CN}$	0.35 (0.13)	0.28 (0.12)	0.22 (0.09)	0.32 (0.15)	0.36 (0.13)	0.33 (0.13)	0.35 (0.15)	0.39 (0.13)	0.53 (0.21)
$Eu_A = Eu/Eu^*$	1.43 (0.20)	1.32 (0.18)	1.34 (0.22)	1.43 (0.23)	1.37 (0.18)	1.34 (0.19)	1.43 (0.23)	1.53 (0.20)	2.38 (0.37)
$Ce_A = Ce/Ce^*$	0.84 (0.09)	0.83 (0.12)	0.90 (0.13)	0.82 (0.14)	0.81 (0.11)	0.79 (0.12)	0.84 (0.14)	0.83 (0.11)	0.84 (0.14)

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TABLE C17. *(continued)*

Sample (ppm)	CMNMC52204 _B_8	CMNMC52204 _B_9	CMNMC52204 _B_10
Li	6 (13.0)	9 (18.0)	≤ LOD
B	23 (6.3)	29 (3.5)	25 (3.2)
Na	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD
Ti	25 (31.0)	9 (37.0)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	4.4 (5.9)
Fe	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	4 (9.2)	≤ LOD
Cu	≤ LOD	2 (2.7)	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD
As	25 (4.6)	43 (7.7)	35 (4.9)
Rb	0.8 (0.9)	1.2 (0.9)	≤ LOD
Sr	189.6 (8.7)	205.0 (31.0)	189.0 (12.0)
Y	282.0 (23.0)	308.0 (45.0)	471.0 (27.0)
Mo	3540 (230.0)	3350 (450.0)	3420 (190.0)
Ag	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD
W	884000 (91000)	840000 (140000)	860000 (53000)
La	16.6 (3.20)	19.9 (2.60)	12.2 (1.00)
Ce	60.0 (10.00)	67.0 (9.60)	51.5 (4.10)
Pr	14.6 (2.00)	14.6 (0.99)	13.4 (0.88)
Nd	119.0 (14.00)	123.0 (16.00)	130.0 (10.00)
Sm	53.6 (5.40)	59.0 (10.00)	77.1 (5.60)
Eu	36.30 (3.70)	28.90 (3.10)	38.70 (2.40)
Gd	88.0 (11.00)	85.0 (15.00)	124.5 (7.80)
Tb	11.7 (1.60)	10.0 (1.30)	17.5 (1.10)
Dy	68.4 (9.10)	64.9 (6.40)	105.1 (8.50)
Ho	13.0 (1.20)	13.4 (2.30)	21.0 (2.00)
Er	33.5 (2.80)	34.1 (6.10)	54.2 (4.30)
Tm	3.6 (0.50)	3.5 (0.58)	5.7 (0.65)
Yb	19.3 (3.30)	20.3 (4.80)	29.0 (2.60)
Lu	3.1 (0.56)	3.1 (0.77)	3.8 (0.29)
∑REE + Y	822.7 (24.1)	854.7 (28.3)	1154.7 (17.9)
$(La/Lu)_{CN}$	0.56 (0.34)	0.66 (0.40)	0.33 (0.13)
$(La/Sm)_{CN}$	0.19 (0.11)	0.21 (0.12)	0.10 (0.04)
$(La/Y)_{CN}$	0.39 (0.20)	0.43 (0.23)	0.17 (0.06)
Eu_A = Eu/Eu*	1.60 (0.31)	1.24 (0.33)	1.19 (0.14)
Ce_A = Ce/Ce*	0.85 (0.24)	0.89 (0.17)	0.84 (0.12)

TABLE C18. Kumbel, Kyrgyzstan (CMNMC 53448).

Sample (ppm)	CMNMC53448 _A_1	CMNMC53448 _A_2	CMNMC53448_ A_3	CMNMC53448_ A_4
Li	2 (4.8)	≤ LOD	9 (6.7)	7 (5.5)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	4 (8.3)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	19 (59.0)	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	4 (1.7)	24 (4.4)	62 (5.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	97.0 (13.0)	225.0 (21.0)	90.0 (13.0)	87.3 (6.1)
Y	≤ LOD	≤ LOD	≤ LOD	1.0 (0.2)
Mo	3330 (350.0)	3050 (230.0)	6670 (860.0)	5490 (230.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	897000 (71000)	827000 (52000)	869000 (63000)	933000 (53000)
La	≤ LOD	2.0 (0.40)	10.0 (1.90)	39.5 (2.30)
Ce	1.1 (0.36)	9.8 (0.96)	35.2 (6.00)	122.4 (8.30)
Pr	0.3 (0.14)	1.9 (0.35)	5.2 (0.77)	13.4 (0.84)
Nd	1.9 (0.33)	8.4 (1.00)	20.0 (3.00)	40.8 (3.10)
Sm	0.5 (0.26)	0.5 (0.27)	1.2 (0.39)	1.8 (0.52)
Eu	0.11 (0.08)	≤ LOD	0.13 (0.07)	0.10 (0.06)
Gd	0.3 (0.25)	0.2 (0.18)	0.6 (0.26)	0.9 (0.34)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	5.0 (1.9)	23.4 (2.5)	72.5 (7.3)	220.4 (9.4)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	0.17 (0.18)	2.49 (2.15)	5.31 (3.83)	13.99 (8.30)
$(La/Y)_{CN}$	3.62 (3.83)	47.24 (38.56)	458.40 (402.54)	270.67 (144.57)
Eu_A = Eu/Eu*	0.77 (0.85)	0.53 (0.62)	0.41 (0.32)	0.22 (0.16)
Ce_A = Ce/Ce*	0.89 (0.73)	1.08 (0.33)	1.16 (0.34)	1.27 (0.15)

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TABLE C18. *(continued)*

Sample (ppm)	CMNMC53448_A_5	CMNMC53448_A_6	CMNMC53448_A_7	CMNMC53448_A_8	CMNMC53448_A_9	CMNMC53448_A_10	CMNMC53448_A_11	CMNMC53448_A_12	CMNMC53448_A_13
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (6.9)	≤ LOD	6 (6.4)	6 (7.9)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	26 (27.0)	≤ LOD
Ti	≤ LOD	10 (17.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5.8 (8.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.2 (0.4)
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (5.2)	≤ LOD	3 (9.7)
Cu	≤ LOD	≤ LOD	≤ LOD	4 (3.1)	≤ LOD	2 (4.5)	≤ LOD	≤ LOD	2 (3.5)
Zn	3 (2.0)	≤ LOD	≤ LOD	2 (2.5)	≤ LOD	2 (4.0)	2 (2.3)	≤ LOD	3 (3.2)
As	63 (7.4)	135 (18.0)	105 (13.0)	109 (14.0)	189 (27.0)	376 (77.0)	169 (15.0)	172 (19.0)	222 (14.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	80.2 (7.6)	86.0 (9.9)	72.9 (6.5)	82.0 (6.3)	94.0 (13.0)	85.0 (13.0)	80.8 (8.0)	84.4 (6.6)	89.4 (9.4)
Y	2.1 (0.6)	3.0 (0.8)	3.8 (0.7)	5.0 (0.9)	0.7 (0.5)	0.9 (0.5)	≤ LOD	≤ LOD	≤ LOD
Mo	5720 (730.0)	10700 (2700.0)	4160 (340.0)	5750 (740.0)	14300 (2000.0)	10300 (1200.0)	11970 (980.0)	11420 (900.0)	13400 (1900.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	961000 (96000)	872000 (90000)	884000 (77000)	827000 (72000)	915000 (93000)	850000 (120000)	976000 (87000)	909000 (59000)	910000 (100000)
La	34.9 (3.80)	49.8 (8.90)	42.5 (3.50)	40.4 (2.70)	70.4 (8.90)	133.0 (25.00)	66.9 (6.00)	61.7 (5.10)	74.6 (7.70)
Ce	106.9 (9.40)	162.0 (23.00)	127.4 (8.90)	133.1 (8.10)	200.0 (29.00)	333.0 (70.00)	180.0 (14.00)	171.0 (16.00)	209.0 (23.00)
Pr	13.3 (1.20)	18.7 (2.00)	18.1 (1.20)	17.3 (1.70)	24.8 (3.30)	38.5 (9.30)	19.5 (1.70)	19.1 (1.90)	21.9 (2.40)
Nd	39.7 (3.10)	65.0 (7.80)	74.4 (5.80)	68.3 (6.20)	62.5 (8.20)	91.0 (15.00)	45.4 (4.00)	47.0 (3.50)	55.8 (4.70)
Sm	1.8 (0.50)	4.7 (1.30)	10.1 (1.90)	10.7 (1.60)	2.4 (0.90)	4.1 (1.30)	1.5 (0.54)	1.1 (0.47)	2.2 (0.82)
Eu	0.20 (0.10)	0.59 (0.19)	0.69 (0.17)	0.67 (0.19)	0.27 (0.13)	0.32 (0.19)	0.15 (0.06)	0.15 (0.10)	0.14 (0.10)
Gd	1.2 (0.57)	4.2 (1.60)	6.2 (1.40)	7.3 (1.30)	1.3 (0.58)	1.4 (0.77)	0.6 (0.28)	0.7 (0.34)	≤ LOD
Tb	≤ LOD	0.3 (0.13)	0.4 (0.08)	0.5 (0.11)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.5 (0.25)	1.1 (0.48)	1.6 (0.51)	2.1 (0.76)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	0.5 (0.20)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	200.8 (10.8)	309.8 (26.1)	285.4 (11.6)	286.0 (11.0)	362.6 (31.7)	602.4 (76.4)	314.2 (16.0)	301.1 (17.4)	364.2 (24.9)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	697.15 (1042.04)	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	12.36 (7.73)	6.64 (4.48)	2.64 (1.37)	2.37 (1.10)	18.70 (13.32)	20.33 (14.45)	28.33 (19.10)	35.16 (25.10)	21.06 (14.48)
$(La/Y)_{CN}$	112.61 (69.05)	109.24 (73.51)	74.73 (38.28)	54.03 (26.35)	708.99 (666.75)	1040.03 (937.07)	2456.74 (1953.97)	1108.40 (816.63)	1599.52 (1226.46)
Eu_A = Eu/Eu*	0.40 (0.27)	0.40 (0.22)	0.25 (0.09)	0.22 (0.08)	0.43 (0.33)	0.33 (0.27)	0.42 (0.30)	0.48 (0.45)	0.31 (0.31)
Ce_A = Ce/Ce*	1.19 (0.20)	1.27 (0.32)	1.10 (0.14)	1.20 (0.17)	1.15 (0.27)	1.11 (0.41)	1.18 (0.18)	1.19 (0.19)	1.23 (0.23)

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TABLE C18. *(continued)*

Sample (ppm)	CMNMC53448 _A_14	CMNMC53448 _A_15	CMNMC53448 _A_16	CMNMC53448 _B_2	CMNMC53448 _B_3	CMNMC53448 _B_4	CMNMC53448 _B_9	CMNMC53448_ B_10	CMNMC53448_ B_11
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (6.0)	≤ LOD	4 (5.4)	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	130 (95.0)	143 (64.0)	110 (44.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	9 (7.8)	4 (10.0)	2 (7.8)	2 (7.9)	≤ LOD	3 (9.8)	11 (15.0)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	2 (8.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3.3 (7.5)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	39 (81.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	1.4 (0.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	6 (4.3)	8 (9.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (3.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	2 (2.0)	≤ LOD	≤ LOD	2 (2.7)	≤ LOD	3 (1.9)	2 (2.6)	≤ LOD	3 (1.9)
As	204 (16.0)	167 (16.0)	163 (20.0)	14 (3.7)	20 (4.0)	54 (8.5)	164 (42.0)	163 (16.0)	408 (47.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.7 (0.4)	≤ LOD	≤ LOD
Sr	80.9 (8.3)	84.7 (6.0)	94.0 (11.0)	163.0 (42.0)	77.7 (6.3)	82.5 (9.6)	82.0 (10.0)	75.7 (6.4)	93.7 (6.1)
Y	≤ LOD	0.5 (0.2)	≤ LOD	≤ LOD	≤ LOD	1.0 (0.3)	3.1 (0.8)	≤ LOD	1.3 (0.4)
Mo	11000 (1100.0)	11360 (820.0)	11700 (1100.0)	4330 (490.0)	4000 (440.0)	5400 (430.0)	13600 (4400.0)	13400 (1500.0)	13600 (1200.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	832000 (73000)	856000 (64000)	910000 (100000)	930000 (110000)	855000 (88000)	900000 (63000)	920000 (86000)	944000 (70000)	940000 (49000)
La	64.9 (5.00)	60.8 (5.40)	56.2 (6.30)	4.9 (1.00)	7.4 (1.30)	36.8 (2.70)	63.0 (14.00)	67.7 (6.40)	151.0 (21.00)
Ce	178.0 (13.00)	166.0 (14.00)	159.0 (18.00)	21.1 (4.30)	25.7 (2.90)	108.4 (9.80)	189.0 (39.00)	178.0 (17.00)	382.0 (45.00)
Pr	18.7 (1.50)	19.4 (1.50)	17.6 (2.00)	3.8 (0.61)	4.1 (0.62)	13.8 (1.20)	21.4 (4.20)	22.7 (2.90)	41.5 (5.40)
Nd	48.7 (3.90)	48.1 (3.30)	46.6 (5.30)	18.8 (4.20)	16.4 (2.70)	36.0 (2.20)	70.0 (11.00)	61.6 (5.10)	99.0 (11.00)
Sm	1.5 (0.48)	1.5 (0.54)	1.6 (0.61)	1.3 (0.63)	1.1 (0.56)	1.8 (0.79)	4.1 (1.40)	1.8 (0.58)	2.7 (0.60)
Eu	0.09 (0.06)	0.15 (0.09)	0.14 (0.09)	0.20 (0.11)	0.18 (0.09)	0.14 (0.07)	0.29 (0.13)	0.25 (0.12)	0.29 (0.11)
Gd	0.3 (0.21)	0.4 (0.23)	0.5 (0.24)	0.5 (0.35)	0.5 (0.35)	0.7 (0.38)	2.0 (0.80)	0.5 (0.28)	1.4 (0.42)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.2 (0.08)	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.9 (0.36)	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	312.3 (14.7)	296.9 (15.6)	282.1 (20.0)	51.2 (6.5)	55.7 (4.7)	199.0 (10.6)	354.4 (43.1)	333.2 (19.2)	679.7 (51.2)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	27.86 (17.75)	25.58 (17.18)	21.48 (14.94)	2.40 (2.00)	4.10 (3.36)	12.54 (8.89)	9.63 (7.23)	23.97 (15.58)	34.67 (20.77)
$(La/Y)_{CN}$	3565.09 (3185.19)	777.16 (556.31)	1131.97 (999.45)	83.51 (69.47)	204.94 (188.22)	252.17 (158.13)	133.79 (93.41)	1153.81 (820.32)	749.00 (508.09)
$Eu_A = Eu/Eu^*$	0.28 (0.24)	0.45 (0.39)	0.37 (0.34)	0.63 (0.62)	0.65 (0.63)	0.30 (0.26)	0.27 (0.19)	0.61 (0.46)	0.41 (0.21)
$Ce_A = Ce/Ce^*$	1.21 (0.17)	1.15 (0.17)	1.21 (0.24)	1.11 (0.36)	1.09 (0.28)	1.15 (0.17)	1.23 (0.45)	1.09 (0.20)	1.14 (0.26)

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TABLE C18. *(continued)*

Sample (ppm)	CMNMC53448 _B_12	CMNMC53448 _B_13	CMNMC53448 _B_14	CMNMC53448 _B_15	CMNMC53448 _B_16	CMNMC53448 _B_17
Li	≤ LOD	≤ LOD	8 (6.5)	≤ LOD	6 (7.0)	≤ LOD
B	115 (42.0)	87 (39.0)	96 (18.0)	77 (27.0)	85 (13.0)	54 (12.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	4 (7.2)	12 (8.1)	≤ LOD	3 (5.8)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	3 (16.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	0.9 (0.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	4 (8.9)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	2 (1.9)	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	510 (31.0)	144 (47.0)	459 (35.0)	303 (51.0)	403 (33.0)	411 (21.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	98.3 (6.9)	115.0 (17.0)	106.9 (5.4)	102.3 (8.8)	89.3 (6.1)	92.3 (4.6)
Y	0.9 (0.2)	≤ LOD	≤ LOD	1.3 (0.4)	1.2 (0.4)	0.6 (0.2)
Mo	12330 (910.0)	10480 (950.0)	11920 (670.0)	10200 (1600.0)	11770 (710.0)	12030 (570.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	929000 (85000)	897000 (82000)	859000 (44000)	834000 (71000)	879000 (76000)	887000 (50000)
La	205.0 (11.00)	65.0 (13.00)	169.0 (12.00)	114.0 (17.00)	130.0 (10.00)	144.2 (7.80)
Ce	487.0 (31.00)	174.0 (36.00)	405.0 (34.00)	273.0 (32.00)	333.0 (25.00)	367.0 (19.00)
Pr	49.3 (3.80)	21.5 (4.10)	44.8 (3.20)	31.0 (3.60)	36.1 (2.90)	40.1 (2.10)
Nd	103.1 (7.60)	54.1 (5.80)	89.4 (6.60)	71.2 (6.90)	89.3 (8.10)	90.2 (4.30)
Sm	2.0 (0.65)	2.8 (0.69)	1.9 (0.45)	3.0 (0.78)	2.6 (0.81)	2.3 (0.46)
Eu	0.34 (0.12)	0.35 (0.14)	0.31 (0.08)	0.42 (0.11)	0.35 (0.14)	0.27 (0.07)
Gd	1.1 (0.36)	0.8 (0.43)	0.8 (0.33)	1.7 (0.56)	1.4 (0.33)	1.0 (0.27)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	0.5 (0.28)	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	849.2 (34.0)	319.2 (39.0)	711.9 (36.9)	496.4 (37.1)	594.4 (28.4)	645.9 (21.2)
$(La/Lu)_{CN}$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$(La/Sm)_{CN}$	65.22 (40.40)	14.34 (9.55)	55.75 (30.93)	24.06 (15.44)	31.10 (19.32)	39.29 (19.81)
$(La/Y)_{CN}$	1497.35 (843.96)	960.09 (970.98)	2674.54 (1751.32)	591.98 (409.05)	714.12 (474.11)	1571.26 (929.04)
Eu_A = Eu/Eu*	0.64 (0.40)	0.54 (0.32)	0.67 (0.32)	0.52 (0.26)	0.50 (0.30)	0.46 (0.19)
Ce_A = Ce/Ce*	1.13 (0.13)	1.11 (0.39)	1.10 (0.15)	1.09 (0.25)	1.15 (0.16)	1.14 (0.11)

TABLE C19. Morro Velho, Brazil (CMNMC 55153).

Sample (ppm)	CMNMC55153_S_1	CMNMC55153_S_2	CMNMC55153_S_3	CMNMC55153_S_4	CMNMC55153_S_5
Li	1 (0.4)	1 (0.4)	1 (0.7)	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1 (0.6)
Mn	2.3 (0.4)	2.3 (0.4)	2.2 (0.4)	3.0 (0.3)	2.9 (0.4)
Fe	2 (0.8)	3 (0.8)	≤ LOD	≤ LOD	4 (0.9)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	4 (0.3)	4 (0.3)	5 (0.5)	4 (0.3)	4 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	509.7 (5.8)	543.6 (5.5)	569.1 (8.1)	566.7 (5.7)	568.6 (6.8)
Y	416.4 (4.2)	421.8 (4.5)	428.8 (7.4)	424.4 (4.0)	444.6 (5.3)
Mo	≤ LOD	≤ LOD	1 (0.1)	1 (0.1)	1 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	982000 (10000)	1003000 (14000)	1008000 (17000)	1024000 (13000)	1035000 (17000)
La	20.0 (0.89)	24.8 (1.30)	25.2 (2.70)	28.0 (1.40)	26.2 (3.00)
Ce	125.7 (3.00)	144.9 (3.80)	147.6 (9.70)	162.7 (4.70)	151.0 (9.30)
Pr	33.9 (0.62)	37.8 (0.86)	38.2 (1.60)	41.8 (0.91)	39.2 (1.50)
Nd	268.7 (4.10)	290.4 (4.50)	298.6 (9.10)	315.1 (4.60)	300.4 (6.30)
Sm	190.1 (2.30)	200.5 (2.70)	208.3 (3.80)	219.3 (2.90)	215.6 (3.70)
Eu	104.70 (1.40)	107.70 (1.50)	111.10 (1.70)	114.00 (1.20)	112.20 (1.80)
Gd	312.8 (4.20)	321.6 (4.40)	338.5 (4.50)	345.2 (4.00)	354.3 (4.50)
Tb	48.0 (0.68)	49.1 (0.57)	51.7 (0.70)	52.1 (0.65)	53.7 (0.69)
Dy	239.2 (3.00)	244.2 (2.90)	254.7 (4.20)	254.8 (3.30)	265.7 (4.00)
Ho	30.7 (0.35)	31.1 (0.33)	32.0 (0.52)	32.0 (0.43)	33.3 (0.52)
Er	49.1 (0.60)	48.9 (0.62)	51.0 (0.84)	49.9 (0.71)	52.6 (0.80)
Tm	3.5 (0.08)	3.5 (0.07)	3.6 (0.08)	3.5 (0.06)	3.8 (0.07)
Yb	10.5 (0.24)	10.6 (0.22)	11.0 (0.25)	10.5 (0.24)	11.3 (0.33)
Lu	0.7 (0.02)	0.7 (0.02)	0.7 (0.03)	0.7 (0.03)	0.8 (0.03)
∑REE + Y	1854.1 (7.9)	1937.6 (8.7)	2001.0 (15.6)	2054.0 (9.2)	2064.7 (13.9)
$(La/Lu)_{CN}$	2.82 (0.78)	3.67 (1.06)	3.50 (1.33)	3.97 (1.16)	3.47 (1.37)
$(La/Sm)_{CN}$	0.07 (0.02)	0.08 (0.02)	0.08 (0.03)	0.08 (0.02)	0.08 (0.03)
$(La/Y)_{CN}$	0.32 (0.07)	0.39 (0.10)	0.39 (0.14)	0.44 (0.11)	0.39 (0.14)
$Eu_A = Eu/Eu^*$	1.30 (0.04)	1.28 (0.04)	1.26 (0.05)	1.25 (0.04)	1.23 (0.04)
$Ce_A = Ce/Ce^*$	0.89 (0.05)	0.91 (0.06)	0.91 (0.10)	0.92 (0.06)	0.91 (0.10)

TABLE C20. Jardine, Montana, USA (CMNMC 80388).

Sample (ppm)	CMNMC80388_S_1	CMNMC80388_S_2	CMNMC80388_S_3	CMNMC80388_S_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	11.9 (0.6)	12.0 (0.6)	12.2 (0.5)	9.6 (0.6)
Fe	≤ LOD	2 (0.8)	3 (1.0)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	2 (0.2)	2 (0.2)
Zn	2 (0.3)	≤ LOD	≤ LOD	≤ LOD
As	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	2859.0 (27.0)	2834.0 (31.0)	2862.0 (35.0)	2890.0 (33.0)
Y	147.4 (2.3)	138.3 (2.8)	93.4 (2.4)	150.6 (2.7)
Mo	1 (0.2)	≤ LOD	≤ LOD	1 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	1060000 (14000)	1070000 (15000)	1056000 (13000)	1061000 (14000)
La	26.1 (0.27)	31.9 (0.74)	25.7 (0.64)	32.5 (0.53)
Ce	84.9 (0.83)	96.3 (1.40)	72.9 (2.00)	103.4 (1.70)
Pr	12.7 (0.17)	13.5 (0.23)	9.5 (0.34)	15.2 (0.34)
Nd	54.6 (0.95)	56.5 (1.10)	36.7 (1.30)	66.0 (1.90)
Sm	16.6 (0.43)	16.7 (0.42)	9.8 (0.39)	20.6 (0.52)
Eu	100.00 (1.00)	107.50 (1.20)	101.00 (1.30)	114.60 (1.20)
Gd	21.4 (0.45)	22.7 (0.61)	12.7 (0.43)	27.9 (0.57)
Tb	4.3 (0.10)	4.2 (0.10)	2.5 (0.07)	5.1 (0.11)
Dy	28.1 (0.59)	27.6 (0.62)	16.7 (0.51)	33.3 (0.70)
Ho	5.2 (0.11)	5.2 (0.13)	3.1 (0.08)	5.9 (0.14)
Er	14.0 (0.29)	13.4 (0.30)	8.6 (0.22)	14.6 (0.31)
Tm	1.9 (0.05)	1.8 (0.05)	1.2 (0.04)	1.8 (0.05)
Yb	10.3 (0.28)	9.1 (0.28)	6.8 (0.19)	9.5 (0.27)
Lu	1.1 (0.03)	0.9 (0.04)	0.7 (0.03)	0.9 (0.03)
∑REE + Y	528.4 (1.9)	545.6 (2.5)	401.2 (2.9)	601.9 (3.1)
$(La/Lu)_{CN}$	2.48 (0.50)	3.55 (0.88)	3.92 (1.00)	3.81 (0.84)
$(La/Sm)_{CN}$	0.99 (0.19)	1.19 (0.26)	1.64 (0.42)	0.99 (0.20)
$(La/Y)_{CN}$	1.18 (0.19)	1.53 (0.32)	1.83 (0.41)	1.43 (0.27)
Eu_A = Eu/Eu*	16.11 (0.69)	16.74 (0.77)	27.53 (1.64)	14.51 (0.61)
Ce_A = Ce/Ce*	1.11 (0.05)	1.11 (0.05)	1.12 (0.07)	1.11 (0.05)

TABLE C21. Yongwol, South Korea (CMNMC 80801).

Sample (ppm)	CMNMC80801_A_1	CMNMC80801_A_2	CMNMC80801_A_3
Li	1 (3.8)	≤ LOD	5 (3.9)
B	68 (54.0)	71 (30.0)	69 (19.0)
Na	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD
Ti	19 (9.2)	3 (11.0)	≤ LOD
V	2 (1.0)	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	5 (10.0)
Mn	101.0 (18.0)	67.0 (12.0)	78.0 (15.0)
Fe	4 (27.0)	≤ LOD	≤ LOD
Co	0.9 (0.8)	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD
Cu	3 (4.7)	≤ LOD	≤ LOD
Zn	≤ LOD	2 (1.7)	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD
Sr	104.0 (10.0)	99.8 (4.6)	103.4 (7.6)
Y	137.0 (30.0)	96.4 (6.8)	106.0 (9.5)
Mo	120 (23.0)	290 (120.0)	180 (60.0)
Ag	≤ LOD	≤ LOD	≤ LOD
Sn	0.5 (0.9)	≤ LOD	0.6 (0.6)
Ba	≤ LOD	≤ LOD	≤ LOD
W	1030000 (120000)	1018000 (54000)	1065000 (76000)
La	207.0 (85.00)	37.4 (2.90)	66.0 (13.00)
Ce	140.0 (57.00)	62.0 (12.00)	63.8 (5.00)
Pr	6.1 (2.50)	5.2 (1.30)	4.4 (0.54)
Nd	16.4 (6.20)	17.2 (4.80)	10.8 (2.10)
Sm	3.4 (1.40)	3.0 (0.74)	2.8 (0.76)
Eu	11.00 (1.60)	6.92 (0.52)	10.12 (0.99)
Gd	4.1 (1.60)	4.6 (1.10)	2.9 (0.72)
Tb	1.2 (0.39)	1.0 (0.19)	0.9 (0.19)
Dy	18.9 (5.10)	11.0 (1.40)	11.3 (1.40)
Ho	5.9 (1.60)	3.1 (0.32)	3.4 (0.40)
Er	25.0 (5.40)	13.1 (1.10)	15.5 (1.60)
Tm	5.1 (1.20)	3.7 (0.27)	3.6 (0.41)
Yb	53.1 (9.50)	36.6 (1.70)	39.0 (3.60)
Lu	7.5 (1.60)	5.6 (0.51)	7.0 (0.73)
∑REE + Y	641.7 (103.3)	307.0 (13.6)	347.6 (14.8)
$(La/Lu)_{CN}$	2.86 (2.26)	0.69 (0.28)	0.97 (0.53)
$(La/Sm)_{CN}$	38.16 (34.60)	7.71 (4.37)	14.57 (9.93)
$(La/Y)_{CN}$	10.04 (7.97)	2.58 (0.99)	4.14 (2.22)
Eu_A = Eu/Eu*	8.94 (5.26)	5.61 (1.97)	10.68 (4.14)
Ce_A = Ce/Ce*	0.49 (0.42)	0.94 (0.25)	0.64 (0.22)

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TABLE C21. *(continued)*

Sample (ppm)	CMNMC80801_A_4	CMNMC80801_A_5	CMNMC80801_A_6	CMNMC80801_A_7	CMNMC80801_A_8	CMNMC80801_A_9	CMNMC80801_A_10	CMNMC80801_A_11	CMNMC80801_A_12
Li	≤ LOD	5 (3.1)	3 (3.0)	≤ LOD	≤ LOD	6 (4.7)	≤ LOD	1 (2.8)	≤ LOD
B	59 (15.0)	56 (9.2)	48 (6.3)	51 (10.0)	37 (10.0)	47 (6.2)	43 (6.7)	38 (6.6)	33 (5.5)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (8.7)	≤ LOD	4 (9.6)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	90.0 (10.0)	100.0 (11.0)	77.0 (8.1)	86.0 (12.0)	32.0 (19.0)	38.0 (15.0)	64.0 (11.0)	44.0 (15.0)	85.0 (13.0)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	3 (7.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (6.5)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2.8)	3 (2.6)	≤ LOD	≤ LOD	3 (1.6)
Zn	≤ LOD	≤ LOD	≤ LOD	3 (2.1)	≤ LOD	2 (1.6)	≤ LOD	≤ LOD	2 (2.1)
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	94.2 (5.2)	107.4 (6.2)	91.7 (6.5)	300.0 (220.0)	108.0 (15.0)	123.5 (9.3)	94.3 (7.6)	118.3 (6.4)	88.9 (8.4)
Y	92.1 (4.6)	118.1 (6.8)	80.0 (5.6)	115.0 (14.0)	89.0 (23.0)	133.0 (11.0)	77.7 (9.6)	80.0 (17.0)	45.3 (4.9)
Mo	200 (37.0)	106 (15.0)	89 (10.0)	172 (77.0)	740 (260.0)	830 (230.0)	232 (56.0)	370 (120.0)	350 (170.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.8)
Ba	≤ LOD	≤ LOD	≤ LOD	3 (4.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	977000 (56000)	990000 (54000)	966000 (64000)	1050000 (81000)	1090000 (120000)	1055000 (66000)	1031000 (73000)	962000 (80000)	955000 (76000)
La	61.9 (3.80)	103.1 (7.50)	46.6 (7.00)	132.0 (81.00)	53.0 (9.80)	77.1 (6.60)	56.5 (2.50)	29.9 (3.90)	38.1 (2.70)
Ce	59.0 (4.10)	81.4 (4.60)	42.4 (5.10)	98.0 (53.00)	116.0 (19.00)	139.0 (14.00)	78.9 (7.30)	47.8 (5.60)	45.0 (11.00)
Pr	3.3 (0.45)	4.7 (0.52)	2.9 (0.47)	12.0 (12.00)	11.0 (2.10)	11.1 (1.40)	5.4 (0.77)	4.8 (1.10)	5.0 (1.90)
Nd	9.9 (1.80)	13.6 (2.10)	7.3 (1.60)	38.0 (34.00)	28.9 (6.20)	31.8 (5.30)	13.7 (2.90)	18.3 (3.90)	13.3 (6.50)
Sm	1.9 (0.65)	2.3 (0.75)	1.5 (0.53)	3.9 (3.60)	4.8 (2.10)	6.5 (1.90)	3.2 (0.90)	4.9 (1.90)	2.1 (1.10)
Eu	11.09 (0.60)	12.90 (1.20)	7.11 (0.81)	9.30 (1.10)	3.80 (1.80)	5.86 (0.67)	2.63 (0.40)	6.01 (0.79)	4.32 (0.49)
Gd	2.3 (0.68)	3.2 (0.69)	1.8 (0.43)	3.6 (1.50)	3.1 (1.30)	5.7 (1.60)	4.1 (1.00)	9.1 (3.40)	1.8 (0.67)
Tb	0.8 (0.15)	1.2 (0.21)	0.7 (0.11)	1.1 (0.34)	1.0 (0.41)	1.4 (0.27)	0.9 (0.25)	2.1 (0.72)	0.4 (0.14)
Dy	9.8 (1.20)	13.7 (1.60)	9.6 (1.20)	13.5 (3.60)	8.9 (3.00)	14.2 (2.00)	9.2 (1.50)	15.9 (4.50)	5.6 (1.10)
Ho	2.9 (0.27)	4.4 (0.54)	3.0 (0.29)	4.3 (0.89)	2.7 (0.73)	4.1 (0.42)	2.8 (0.32)	3.3 (0.91)	1.6 (0.17)
Er	14.6 (1.40)	20.1 (1.40)	14.3 (1.30)	16.9 (2.40)	11.9 (4.10)	15.7 (1.10)	10.1 (0.94)	9.7 (1.90)	6.8 (0.90)
Tm	4.1 (0.30)	5.0 (0.38)	3.7 (0.35)	4.3 (0.54)	2.7 (0.70)	3.4 (0.28)	2.6 (0.35)	2.2 (0.28)	1.9 (0.28)
Yb	42.3 (2.10)	56.5 (3.30)	37.6 (2.70)	46.3 (4.80)	21.1 (4.60)	33.4 (3.80)	22.3 (3.40)	20.8 (2.10)	20.2 (2.40)
Lu	6.9 (0.48)	9.4 (0.57)	6.5 (0.68)	6.9 (0.87)	3.1 (0.49)	4.9 (0.53)	3.1 (0.37)	3.1 (0.33)	2.9 (0.29)
∑REE + Y	322.9 (6.6)	449.5 (10.0)	264.9 (9.5)	505.1 (103.6)	361.1 (23.6)	487.2 (17.2)	293.1 (9.3)	257.9 (10.4)	194.3 (13.6)
$(La/Lu)_{CN}$	0.93 (0.34)	1.14 (0.41)	0.74 (0.38)	1.99 (1.71)	1.78 (1.04)	1.62 (0.71)	1.89 (0.76)	1.01 (0.49)	1.35 (0.56)
$(La/Sm)_{CN}$	20.00 (12.59)	28.34 (17.96)	20.14 (14.47)	21.21 (26.30)	6.92 (5.46)	7.43 (4.57)	11.10 (6.34)	3.82 (2.75)	11.37 (8.77)
$(La/Y)_{CN}$	4.47 (1.49)	5.80 (2.09)	3.87 (1.82)	7.63 (6.54)	3.96 (2.64)	3.85 (1.58)	4.83 (1.98)	2.48 (1.45)	5.59 (2.37)
$Eu_A = Eu/Eu^*$	15.98 (7.30)	14.48 (5.80)	13.43 (6.19)	7.41 (8.52)	2.80 (2.26)	2.86 (1.24)	2.21 (0.89)	2.70 (1.51)	6.60 (4.70)
$Ce_A = Ce/Ce^*$	0.65 (0.09)	0.55 (0.08)	0.61 (0.18)	0.47 (0.56)	1.10 (0.35)	1.02 (0.18)	0.87 (0.12)	0.87 (0.23)	0.68 (0.23)

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TABLE C21. *(continued)*

Sample (ppm)	CMNMC80801_A_ 13
Li	≤ LOD
B	19 (15.0)
Na	≤ LOD
K	29 (15.0)
Ti	≤ LOD
V	2 (1.6)
Cr	≤ LOD
Mn	83.0 (10.0)
Fe	≤ LOD
Co	≤ LOD
Ni	7 (10.0)
Cu	5 (2.0)
Zn	2 (1.5)
As	7 (7.1)
Rb	≤ LOD
Sr	93.3 (4.4)
Y	46.4 (7.4)
Mo	194 (91.0)
Ag	≤ LOD
Sn	0.6 (0.7)
Ba	≤ LOD
W	987000 (66000)
La	37.0 (2.50)
Ce	43.1 (7.50)
Pr	2.6 (0.65)
Nd	4.9 (1.40)
Sm	0.6 (0.38)
Eu	3.09 (0.36)
Gd	1.6 (0.67)
Tb	0.4 (0.11)
Dy	5.4 (1.20)
Ho	1.4 (0.22)
Er	6.6 (1.00)
Tm	1.9 (0.23)
Yb	20.1 (1.50)
Lu	2.9 (0.39)
∑REE + Y	178.0 (8.4)
$(La/Lu)_{CN}$	1.33 (0.60)
$(La/Sm)_{CN}$	36.81 (30.15)
$(La/Y)_{CN}$	5.30 (2.53)
$Eu_A = Eu/Eu^*$	8.88 (6.21)
$Ce_A = Ce/Ce^*$	0.76 (0.17)

TABLE C22. Sanford, Maine, USA (CMNMC 85546).

Sample (ppm)	CMNMC85546_S_ 1	CMNMC85546_S_ 2	CMNMC85546_S_ 3	CMNMC85546_S_ 4	CMNMC85546_S_ 5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	9.8 (0.4)	9.2 (0.4)	9.5 (0.4)	10.0 (0.4)	8.8 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	173.3 (2.2)	185.8 (2.1)	140.8 (1.5)	186.3 (2.6)	126.7 (1.5)
Y	3.6 (0.1)	3.0 (0.1)	1.4 (0.0)	2.0 (0.1)	1.2 (0.1)
Mo	600 (11.0)	689 (7.5)	456 (6.0)	692 (12.0)	428 (4.7)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	809000 (12000)	812000 (13000)	816700 (9400)	819000 (11000)	810100 (9100)
La	8.8 (0.12)	8.2 (0.12)	7.7 (0.09)	6.4 (0.12)	6.7 (0.13)
Ce	14.9 (0.18)	14.0 (0.23)	10.5 (0.14)	10.8 (0.16)	11.0 (0.13)
Pr	1.6 (0.05)	1.5 (0.04)	1.0 (0.03)	1.2 (0.03)	1.1 (0.04)
Nd	6.4 (0.18)	6.1 (0.16)	3.1 (0.12)	4.4 (0.15)	3.9 (0.12)
Sm	1.2 (0.08)	1.0 (0.06)	0.5 (0.05)	0.7 (0.06)	0.7 (0.06)
Eu	0.18 (0.01)	0.14 (0.01)	0.26 (0.02)	0.12 (0.01)	0.35 (0.02)
Gd	0.9 (0.06)	0.7 (0.06)	0.5 (0.04)	0.6 (0.06)	0.5 (0.04)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.8 (0.04)	0.7 (0.04)	≤ LOD	0.5 (0.04)	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	0.4 (0.03)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	39.4 (0.3)	36.1 (0.3)	25.5 (0.2)	27.2 (0.3)	25.9 (0.2)
$(La/Lu)_{CN}$	34.87 (14.09)	38.40 (16.43)	110.57 (59.52)	41.54 (19.44)	192.98 (135.46)
$(La/Sm)_{CN}$	4.71 (1.35)	5.23 (1.45)	9.64 (3.07)	5.82 (1.90)	6.20 (2.00)
$(La/Y)_{CN}$	16.16 (3.27)	18.24 (3.65)	36.04 (7.57)	20.99 (4.57)	37.14 (10.14)
$Eu_A = Eu/Eu^*$	0.51 (0.06)	0.50 (0.07)	1.56 (0.23)	0.54 (0.09)	1.77 (0.26)
$Ce_A = Ce/Ce^*$	0.89 (0.04)	0.89 (0.04)	0.80 (0.04)	0.88 (0.04)	0.89 (0.04)

TABLE C23. Carrock Fell, United Kingdom (CMNMC 85817).

Sample (ppm)	CMNMC85817_S 1_1	CMNMC85817_S 1_2	CMNMC85817_S 1_3	CMNMC85817_S 1_4	CMNMC85817_S 2_1	CMNMC85817_S 2_2	CMNMC85817_S 2_3	CMNMC85817_S 2_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	112.8 (1.6)	113.5 (1.6)	118.4 (1.3)	109.4 (1.6)	109.2 (1.4)	112.0 (1.8)	105.4 (1.6)	108.8 (1.5)
Fe	≤ LOD	≤ LOD	≤ LOD	2 (1.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	2 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	2 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	2 (0.3)	≤ LOD	≤ LOD	5 (0.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	115.6 (1.4)	136.6 (1.4)	121.2 (1.5)	114.2 (2.3)	149.4 (1.9)	117.0 (1.3)	117.7 (1.5)	113.4 (1.2)
Y	30.9 (0.4)	24.9 (0.3)	18.1 (0.3)	20.8 (0.4)	10.8 (0.2)	15.3 (0.3)	14.9 (0.3)	15.8 (0.4)
Mo	4 (0.4)	3 (0.2)	4 (0.2)	8 (0.7)	3 (0.2)	2 (0.2)	3 (0.2)	2 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	1083000 (14000)	1094000 (14000)	1087000 (15000)	1091000 (15000)	1049000 (15000)	1060000 (14000)	1074000 (16000)	1056000 (15000)
La	5.9 (0.21)	3.0 (0.08)	4.0 (0.13)	1.6 (0.06)	0.9 (0.04)	5.0 (0.10)	0.8 (0.04)	2.3 (0.07)
Ce	5.6 (0.14)	1.7 (0.05)	1.4 (0.05)	1.4 (0.05)	0.4 (0.03)	3.2 (0.06)	0.5 (0.03)	3.0 (0.12)
Pr	0.4 (0.02)	≤ LOD	≤ LOD	0.2 (0.02)	≤ LOD	0.2 (0.02)	≤ LOD	0.3 (0.02)
Nd	1.9 (0.24)	≤ LOD	≤ LOD	1.6 (0.18)	≤ LOD	≤ LOD	≤ LOD	1.5 (0.12)
Sm	1.6 (0.24)	≤ LOD	≤ LOD	1.4 (0.23)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.07)
Eu	5.81 (0.38)	2.69 (0.08)	11.13 (0.23)	3.04 (0.13)	0.87 (0.03)	2.83 (0.07)	0.82 (0.04)	1.41 (0.06)
Gd	2.6 (0.31)	0.5 (0.05)	0.7 (0.08)	2.0 (0.28)	≤ LOD	0.3 (0.05)	0.3 (0.04)	0.6 (0.06)
Tb	0.6 (0.04)	0.3 (0.01)	0.2 (0.02)	0.4 (0.04)	≤ LOD	≤ LOD	≤ LOD	0.2 (0.01)
Dy	5.1 (0.23)	3.2 (0.12)	2.1 (0.11)	3.0 (0.14)	1.1 (0.07)	1.6 (0.08)	1.5 (0.07)	1.8 (0.08)
Ho	1.3 (0.04)	0.9 (0.03)	0.6 (0.03)	0.7 (0.04)	0.3 (0.02)	0.5 (0.02)	0.4 (0.02)	0.5 (0.02)
Er	4.8 (0.16)	3.8 (0.12)	2.4 (0.09)	3.0 (0.12)	1.6 (0.06)	2.1 (0.08)	2.1 (0.08)	2.2 (0.09)
Tm	1.0 (0.03)	0.9 (0.03)	0.6 (0.03)	0.7 (0.04)	0.4 (0.02)	0.6 (0.02)	0.6 (0.02)	0.6 (0.02)
Yb	9.7 (0.25)	8.6 (0.22)	5.9 (0.28)	7.1 (0.23)	4.5 (0.15)	6.3 (0.17)	5.5 (0.18)	5.9 (0.18)
Lu	1.4 (0.04)	1.4 (0.04)	1.0 (0.04)	1.2 (0.04)	0.8 (0.03)	1.1 (0.04)	0.9 (0.03)	1.0 (0.03)
∑REE + Y	78.6 (0.8)	52.3 (0.3)	48.8 (0.4)	48.1 (0.5)	22.0 (0.2)	39.7 (0.3)	28.8 (0.2)	37.5 (0.3)
$(La/Lu)_{CN}$	0.43 (0.11)	0.23 (0.05)	0.42 (0.12)	0.13 (0.03)	0.12 (0.03)	0.46 (0.11)	0.09 (0.03)	0.23 (0.06)
$(La/Sm)_{CN}$	2.29 (0.98)	11.32 (5.57)	7.79 (3.39)	0.70 (0.32)	16.35 (10.90)	16.17 (7.13)	4.49 (2.41)	2.97 (1.21)
$(La/Y)_{CN}$	1.28 (0.28)	0.81 (0.16)	1.48 (0.33)	0.50 (0.12)	0.56 (0.14)	2.18 (0.43)	0.38 (0.10)	0.96 (0.22)
$Eu_A = Eu/Eu^*$	8.54 (1.70)	25.44 (4.86)	68.41 (12.88)	5.63 (1.26)	28.48 (9.97)	33.57 (8.08)	13.70 (3.70)	7.87 (1.39)
$Ce_A = Ce/Ce^*$	0.62 (0.05)	0.40 (0.03)	0.25 (0.02)	0.51 (0.04)	0.36 (0.04)	0.45 (0.03)	0.44 (0.05)	0.74 (0.06)

TABLE C24. Sigma, QC, Canada (CMNMC 86063).

Sample (ppm)	CMNMC86063_S_1	CMNMC86063_S_2	CMNMC86063_S_3	CMNMC86063_S_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	7.3 (0.4)	6.9 (0.4)	6.7 (0.4)	8.8 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	9 (0.5)	9 (0.5)	6 (0.3)	11 (0.7)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	282.8 (3.0)	260.0 (3.1)	283.2 (2.7)	289.9 (3.0)
Y	409.7 (4.5)	397.9 (4.6)	360.3 (3.1)	406.1 (2.9)
Mo	15 (0.5)	16 (0.5)	17 (0.5)	15 (0.5)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	914000 (13000)	948000 (13000)	949000 (14000)	956000 (11000)
La	9.3 (0.15)	6.8 (0.14)	4.9 (0.10)	8.6 (0.14)
Ce	58.8 (0.68)	48.1 (0.67)	36.3 (0.45)	57.3 (0.60)
Pr	16.0 (0.23)	13.6 (0.21)	10.7 (0.13)	15.2 (0.18)
Nd	125.8 (1.60)	106.5 (1.20)	82.8 (1.20)	117.4 (1.50)
Sm	69.4 (1.20)	57.5 (0.87)	44.6 (0.77)	66.9 (0.97)
Eu	55.11 (0.76)	54.18 (0.65)	64.51 (0.74)	56.09 (0.59)
Gd	112.2 (1.80)	95.6 (1.30)	67.3 (0.91)	108.6 (1.20)
Tb	18.5 (0.30)	16.8 (0.23)	12.3 (0.15)	18.5 (0.21)
Dy	116.3 (1.30)	107.0 (1.70)	82.8 (0.89)	115.9 (1.40)
Ho	19.8 (0.27)	18.9 (0.28)	14.6 (0.15)	19.5 (0.23)
Er	43.6 (0.61)	43.0 (0.53)	35.1 (0.49)	43.0 (0.48)
Tm	4.3 (0.09)	4.5 (0.08)	4.0 (0.08)	4.4 (0.07)
Yb	16.8 (0.31)	18.1 (0.36)	16.6 (0.35)	17.1 (0.30)
Lu	1.4 (0.04)	1.5 (0.04)	1.4 (0.04)	1.4 (0.04)
∑REE + Y	1077.0 (3.3)	989.8 (2.9)	838.0 (2.2)	1055.9 (2.8)
$(La/Lu)_{CN}$	0.69 (0.14)	0.47 (0.10)	0.37 (0.08)	0.65 (0.13)
$(La/Sm)_{CN}$	0.08 (0.02)	0.07 (0.01)	0.07 (0.01)	0.08 (0.01)
$(La/Y)_{CN}$	0.15 (0.02)	0.11 (0.02)	0.09 (0.02)	0.14 (0.02)
Eu_A = Eu/Eu*	1.89 (0.07)	2.21 (0.08)	3.57 (0.13)	1.99 (0.06)
Ce_A = Ce/Ce*	0.89 (0.05)	0.88 (0.05)	0.86 (0.04)	0.92 (0.05)

TABLE C25. Cantung, NWT, Canada (CXXXX).

Sample (ppm)	CXXXX_A_S_1	CXXXX_A_S_2	CXXXX_A_S_3
Li	≤ LOD	2 (0.2)	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD
Mn	18.8 (0.4)	18.3 (0.3)	21.7 (0.6)
Fe	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD
As	2 (0.1)	≤ LOD	2 (0.1)
Rb	≤ LOD	≤ LOD	≤ LOD
Sr	49.7 (0.8)	51.3 (1.0)	49.4 (1.0)
Y	133.7 (2.8)	45.9 (1.7)	94.5 (1.6)
Mo	111 (2.1)	112 (2.6)	125 (2.7)
Ag	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD
W	559600 (7500)	548000 (10000)	560700 (8300)
La	122.2 (5.90)	28.4 (2.80)	147.2 (4.00)
Ce	274.0 (11.00)	87.3 (5.70)	316.4 (7.30)
Pr	34.3 (1.20)	12.9 (0.65)	36.3 (0.73)
Nd	145.0 (4.40)	59.0 (2.00)	135.1 (2.80)
Sm	27.4 (0.74)	11.0 (0.35)	19.3 (0.36)
Eu	25.25 (0.44)	16.12 (0.33)	22.66 (0.49)
Gd	22.9 (0.44)	9.4 (0.26)	14.9 (0.32)
Tb	3.6 (0.07)	1.3 (0.03)	2.1 (0.05)
Dy	23.4 (0.46)	8.7 (0.26)	14.1 (0.29)
Ho	4.9 (0.10)	1.8 (0.05)	3.0 (0.06)
Er	15.1 (0.31)	5.8 (0.20)	10.2 (0.20)
Tm	2.4 (0.06)	0.8 (0.04)	1.7 (0.04)
Yb	17.4 (0.34)	5.8 (0.27)	12.7 (0.27)
Lu	2.5 (0.05)	0.8 (0.04)	1.7 (0.04)
∑REE + Y	854.2 (13.3)	295.1 (6.7)	831.9 (8.9)
$(La/Lu)_{CN}$	5.01 (1.29)	3.70 (1.42)	8.84 (1.98)
$(La/Sm)_{CN}$	2.79 (0.77)	1.62 (0.58)	4.78 (1.02)
$(La/Y)_{CN}$	6.08 (1.60)	4.11 (1.51)	10.35 (2.17)
Eu_A = Eu/Eu*	2.97 (0.14)	4.71 (0.26)	3.90 (0.17)
Ce_A = Ce/Ce*	1.00 (0.08)	1.09 (0.14)	1.01 (0.06)

(continued on next page)

TABLE C25. *(continued)*

Sample (ppm)	CXXXX_A_S_4	CXXXX_A_S_5	CXXXX_A_S_6	CXXXX_A_S_7	CXXXX_A_S_8	CXXXX_A_S_9	CXXXX_A_S_10	CXXXX_A_S_11	CXXXX_A_S_12
Li	≤ LOD	1 (0.2)	≤ LOD	1 (0.2)	≤ LOD	2 (0.2)	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (0.9)	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	16.6 (0.7)	14.1 (0.5)	18.5 (0.4)	44.7 (4.9)	11.3 (0.6)	88.0 (21.0)	14.2 (0.4)	22.4 (0.7)	16.0 (0.4)
Fe	7 (6.6)	3 (1.7)	≤ LOD	269 (52.0)	≤ LOD	540 (180.0)	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.1)	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	56.4 (1.1)	51.2 (1.1)	46.2 (0.8)	50.4 (1.1)	55.6 (1.1)	48.8 (1.3)	49.2 (1.0)	52.8 (1.1)	51.8 (1.1)
Y	28.5 (0.8)	78.8 (3.2)	87.0 (1.5)	73.9 (4.4)	45.5 (1.4)	79.4 (5.7)	22.9 (0.4)	168.6 (4.5)	42.9 (0.8)
Mo	130 (3.7)	107 (4.0)	110 (2.0)	115 (1.8)	115 (2.6)	104 (2.2)	135 (2.9)	105 (2.7)	118 (2.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	571000 (11000)	573000 (12000)	562400 (7900)	572000 (10000)	560000 (11000)	566300 (9100)	571800 (9400)	575000 (11000)	581200 (8500)
La	19.6 (0.32)	51.6 (6.60)	84.1 (1.90)	126.0 (19.00)	20.6 (0.66)	70.0 (13.00)	13.2 (0.27)	163.0 (11.00)	23.8 (0.48)
Ce	47.3 (0.85)	131.0 (11.00)	212.5 (4.50)	262.0 (32.00)	65.1 (2.30)	154.0 (21.00)	38.5 (0.82)	328.0 (12.00)	63.8 (1.20)
Pr	6.4 (0.14)	18.9 (1.20)	27.0 (0.48)	28.5 (2.80)	9.9 (0.40)	20.2 (2.10)	5.2 (0.11)	41.9 (1.40)	9.2 (0.19)
Nd	29.8 (0.74)	92.9 (4.80)	114.6 (2.20)	102.4 (7.50)	50.6 (1.80)	90.5 (7.20)	24.2 (0.51)	180.1 (4.80)	46.3 (0.87)
Sm	6.6 (0.20)	20.6 (0.83)	18.7 (0.32)	14.6 (0.84)	12.0 (0.39)	17.8 (1.20)	5.5 (0.14)	35.1 (0.83)	10.6 (0.23)
Eu	3.94 (0.10)	17.70 (0.53)	17.93 (0.32)	23.37 (0.79)	8.96 (0.36)	25.71 (0.55)	3.32 (0.08)	29.46 (0.64)	6.23 (0.13)
Gd	6.4 (0.22)	19.3 (0.81)	15.8 (0.34)	11.2 (0.50)	12.2 (0.40)	14.0 (0.87)	5.5 (0.16)	26.7 (0.70)	10.2 (0.25)
Tb	0.9 (0.03)	2.8 (0.09)	2.2 (0.05)	1.6 (0.08)	1.7 (0.06)	2.1 (0.13)	0.8 (0.03)	4.0 (0.11)	1.5 (0.04)
Dy	5.6 (0.17)	17.9 (0.66)	14.5 (0.34)	10.8 (0.50)	10.6 (0.30)	13.3 (0.78)	4.9 (0.13)	26.0 (0.67)	9.4 (0.20)
Ho	1.1 (0.04)	3.6 (0.12)	3.2 (0.08)	2.3 (0.10)	2.0 (0.07)	2.8 (0.16)	1.0 (0.02)	5.2 (0.14)	1.8 (0.03)
Er	3.1 (0.10)	10.2 (0.42)	10.1 (0.22)	7.9 (0.38)	5.4 (0.16)	8.9 (0.55)	2.7 (0.07)	16.8 (0.45)	5.1 (0.12)
Tm	0.4 (0.02)	1.4 (0.07)	1.5 (0.03)	1.3 (0.07)	0.6 (0.03)	1.5 (0.09)	0.3 (0.02)	2.8 (0.07)	0.7 (0.02)
Yb	3.3 (0.14)	9.0 (0.44)	10.5 (0.21)	9.9 (0.49)	3.8 (0.19)	11.6 (0.82)	2.0 (0.09)	23.5 (0.69)	4.1 (0.12)
Lu	≤ LOD	1.3 (0.08)	1.3 (0.04)	1.3 (0.07)	≤ LOD	1.6 (0.11)	≤ LOD	3.4 (0.10)	0.5 (0.02)
∑REE + Y	163.4 (1.2)	477.1 (13.8)	621.0 (5.4)	677.1 (38.1)	249.4 (3.1)	513.4 (25.9)	130.3 (1.0)	1054.4 (17.1)	236.0 (1.6)
$(La/Lu)_{CN}$	4.47 (1.20)	4.04 (1.76)	6.75 (1.57)	10.19 (4.59)	4.77 (1.49)	4.45 (2.24)	6.03 (1.53)	4.99 (1.56)	4.57 (1.08)
$(La/Sm)_{CN}$	1.85 (0.40)	1.57 (0.64)	2.82 (0.56)	5.39 (2.46)	1.08 (0.27)	2.46 (1.24)	1.50 (0.32)	2.91 (0.88)	1.41 (0.29)
$(La/Y)_{CN}$	4.56 (0.98)	4.35 (1.79)	6.43 (1.28)	11.33 (5.20)	3.01 (0.75)	5.86 (2.97)	3.84 (0.73)	6.43 (1.97)	3.69 (0.73)
$Eu_A = Eu/Eu^*$	1.81 (0.10)	2.65 (0.19)	3.09 (0.13)	5.34 (0.48)	2.23 (0.15)	4.78 (0.49)	1.80 (0.09)	2.81 (0.14)	1.80 (0.08)
$Ce_A = Ce/Ce^*$	1.01 (0.05)	1.01 (0.17)	1.06 (0.05)	1.01 (0.24)	1.09 (0.08)	0.97 (0.26)	1.11 (0.06)	0.93 (0.09)	1.04 (0.05)

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TABLE C25. *(continued)*

Sample (ppm)	CXXXX_A_S_13	CXXXX_A_S_14	CXXXX_A_S_15	CXXXX_A_S_16	CXXXX_B_S_1	CXXXX_B_S_2	CXXXX_B_S_3	CXXXX_B_S_4	CXXXX_B_S_5
Li	3 (0.3)	2 (0.2)	2 (0.2)	3 (0.3)	2 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	42 (43.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	14.1 (0.4)	14.2 (0.5)	12.7 (0.4)	16.5 (0.3)	13.6 (0.3)	29.8 (0.6)	28.2 (0.7)	15.1 (0.3)	19.6 (0.3)
Fe	≤ LOD	≤ LOD	108 (8.9)	54 (19.0)	≤ LOD	≤ LOD	≤ LOD	2 (1.9)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	2 (0.2)	2 (0.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.2)	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	49.6 (1.0)	51.8 (0.9)	51.8 (0.8)	54.2 (1.0)	53.6 (0.6)	59.0 (0.8)	59.0 (1.1)	58.3 (1.0)	52.2 (0.8)
Y	9.5 (0.2)	14.4 (0.5)	9.6 (0.2)	33.6 (0.5)	81.1 (1.2)	232.0 (7.8)	306.9 (8.3)	302.1 (8.0)	110.5 (2.3)
Mo	277 (5.8)	280 (4.9)	277 (5.8)	112 (1.9)	122 (1.8)	78 (1.7)	78 (1.3)	66 (1.2)	109 (1.8)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	590700 (8300)	589000 (8900)	584400 (7300)	591500 (7700)	745700 (8900)	725000 (9900)	728000 (11000)	748000 (11000)	743000 (11000)
La	19.9 (1.70)	38.6 (0.89)	21.4 (0.66)	24.4 (0.79)	55.0 (6.90)	199.0 (22.00)	329.0 (14.00)	109.3 (9.80)	119.0 (10.00)
Ce	53.8 (2.10)	104.6 (2.00)	62.5 (1.10)	76.5 (1.30)	114.2 (8.30)	430.0 (36.00)	663.0 (27.00)	358.0 (19.00)	227.0 (12.00)
Pr	6.9 (0.20)	11.9 (0.20)	7.8 (0.17)	11.2 (0.20)	11.6 (0.53)	38.6 (2.50)	57.8 (1.80)	44.5 (1.50)	18.8 (0.70)
Nd	30.0 (0.64)	47.1 (0.97)	32.6 (0.60)	56.9 (0.93)	33.0 (0.91)	88.2 (4.40)	124.4 (3.70)	139.9 (3.50)	40.7 (1.00)
Sm	4.8 (0.16)	7.4 (0.18)	5.1 (0.16)	12.4 (0.31)	6.4 (0.17)	11.4 (0.40)	15.2 (0.46)	24.4 (0.45)	6.0 (0.21)
Eu	5.61 (0.13)	5.57 (0.12)	5.63 (0.12)	9.56 (0.17)	19.33 (0.28)	26.51 (0.46)	32.14 (0.45)	19.70 (0.41)	28.86 (0.39)
Gd	4.1 (0.14)	5.9 (0.16)	4.0 (0.12)	11.4 (0.24)	5.0 (0.14)	6.6 (0.27)	8.5 (0.25)	15.7 (0.33)	3.8 (0.14)
Tb	0.5 (0.01)	0.7 (0.03)	0.5 (0.02)	1.4 (0.04)	1.0 (0.03)	1.5 (0.06)	2.0 (0.06)	3.5 (0.06)	0.9 (0.03)
Dy	2.7 (0.08)	3.9 (0.14)	2.5 (0.09)	8.5 (0.17)	7.8 (0.18)	15.0 (0.40)	19.4 (0.52)	30.7 (0.67)	7.8 (0.20)
Ho	0.4 (0.02)	0.6 (0.02)	0.4 (0.02)	1.6 (0.03)	1.8 (0.04)	3.6 (0.10)	4.7 (0.12)	6.9 (0.15)	1.8 (0.05)
Er	0.9 (0.04)	1.1 (0.06)	0.7 (0.04)	4.0 (0.08)	7.2 (0.11)	17.7 (0.45)	23.6 (0.55)	28.1 (0.77)	8.9 (0.19)
Tm	≤ LOD	≤ LOD	≤ LOD	0.5 (0.02)	1.7 (0.04)	5.1 (0.16)	6.8 (0.18)	6.0 (0.18)	2.5 (0.06)
Yb	≤ LOD	0.5 (0.04)	≤ LOD	3.1 (0.09)	15.6 (0.28)	50.3 (1.60)	69.0 (1.90)	48.2 (1.80)	26.5 (0.59)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2.4 (0.05)	7.5 (0.23)	10.0 (0.28)	6.3 (0.26)	4.1 (0.09)
∑REE + Y	139.5 (2.8)	242.5 (2.4)	152.9 (1.4)	255.3 (1.9)	363.0 (10.9)	1133.1 (42.5)	1672.4 (30.8)	1143.2 (21.8)	607.1 (15.7)
$(La/Lu)_{CN}$	96.73 (47.44)	77.39 (31.22)	133.54 (64.02)	6.45 (1.62)	2.38 (0.91)	2.75 (1.03)	3.40 (0.90)	1.79 (0.65)	3.03 (0.98)
$(La/Sm)_{CN}$	2.60 (0.90)	3.26 (0.71)	2.63 (0.65)	1.23 (0.29)	5.39 (2.10)	10.92 (4.17)	13.57 (3.66)	2.81 (0.92)	12.37 (4.26)
$(La/Y)_{CN}$	13.86 (4.48)	17.79 (4.25)	14.85 (3.38)	4.82 (1.05)	4.51 (1.69)	5.70 (2.16)	7.13 (1.88)	2.40 (0.82)	7.16 (2.32)
$Eu_A = Eu/Eu^*$	3.73 (0.22)	2.47 (0.12)	3.66 (0.21)	2.40 (0.11)	10.02 (0.49)	8.52 (0.54)	7.83 (0.43)	2.87 (0.12)	17.04 (1.02)
$Ce_A = Ce/Ce^*$	1.10 (0.12)	1.16 (0.06)	1.16 (0.06)	1.11 (0.06)	1.04 (0.19)	1.11 (0.20)	1.07 (0.09)	1.23 (0.14)	1.05 (0.14)

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TABLE C25. *(continued)*

Sample (ppm)	CXXXX_B_S_6	CXXXX_B_S_7	CXXXX_B_S_8	CXXXX_B_S_9	CXXXX_B_S_10	CXXXX_B_S_11	CXXXX_B_S_12	CXXXX_B_S_13	CXXXX_B_S_14
Li	≤ LOD	2 (0.2)	≤ LOD	2 (0.2)	≤ LOD	3 (0.4)	≤ LOD	3 (0.3)	1 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	18.1 (0.4)	19.2 (0.5)	20.5 (0.4)	16.4 (0.7)	16.7 (0.4)	21.7 (0.4)	9.2 (0.4)	16.3 (0.4)	15.6 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	460 (110.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	17 (6.3)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	55.7 (0.9)	50.1 (0.8)	55.5 (0.8)	55.1 (0.7)	54.4 (0.7)	62.6 (1.0)	60.0 (0.7)	49.2 (0.7)	56.2 (0.8)
Y	64.8 (0.8)	82.0 (2.2)	138.7 (4.4)	69.8 (2.4)	89.9 (2.1)	99.7 (8.4)	15.8 (1.6)	71.0 (1.9)	64.9 (1.0)
Mo	87 (1.5)	104 (1.8)	95 (1.6)	169 (3.2)	103 (1.4)	88 (1.5)	311 (4.6)	110 (3.2)	105 (2.9)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	744000 (9700)	736300 (9300)	745900 (8500)	760300 (9500)	755000 (11000)	760000 (10000)	773400 (8800)	765100 (9200)	780000 (11000)
La	101.3 (1.40)	69.0 (3.20)	196.0 (13.00)	74.0 (11.00)	112.5 (5.30)	163.0 (23.00)	16.8 (2.10)	41.5 (2.00)	55.7 (0.87)
Ce	157.4 (2.10)	149.4 (5.30)	332.0 (19.00)	138.0 (13.00)	204.7 (8.70)	267.0 (31.00)	34.4 (3.70)	102.2 (3.00)	125.9 (1.60)
Pr	11.1 (0.18)	13.3 (0.42)	24.5 (1.10)	12.0 (0.84)	16.8 (0.56)	18.9 (1.50)	3.6 (0.29)	10.5 (0.22)	11.2 (0.18)
Nd	19.9 (0.29)	31.5 (0.78)	46.4 (1.60)	30.2 (1.10)	36.7 (0.87)	37.5 (2.70)	15.4 (0.68)	30.2 (0.51)	25.0 (0.35)
Sm	2.6 (0.13)	5.1 (0.17)	5.6 (0.18)	5.6 (0.26)	5.5 (0.18)	5.0 (0.38)	3.5 (0.14)	5.7 (0.17)	3.1 (0.13)
Eu	14.11 (0.21)	24.17 (0.42)	35.39 (0.44)	17.37 (0.45)	25.31 (0.33)	31.57 (0.44)	3.23 (0.46)	17.98 (0.69)	14.09 (0.32)
Gd	1.7 (0.10)	3.2 (0.12)	3.4 (0.16)	4.3 (0.16)	3.6 (0.12)	2.9 (0.19)	2.5 (0.12)	4.4 (0.12)	2.0 (0.10)
Tb	0.4 (0.02)	0.7 (0.02)	0.8 (0.03)	0.8 (0.02)	0.7 (0.02)	0.6 (0.04)	0.3 (0.02)	0.9 (0.02)	0.4 (0.02)
Dy	3.8 (0.12)	6.0 (0.16)	7.8 (0.25)	6.4 (0.18)	6.5 (0.16)	5.6 (0.34)	2.2 (0.13)	6.9 (0.17)	4.3 (0.12)
Ho	1.0 (0.03)	1.4 (0.04)	1.9 (0.07)	1.4 (0.04)	1.5 (0.03)	1.3 (0.11)	0.4 (0.03)	1.5 (0.03)	1.0 (0.03)
Er	5.0 (0.10)	6.5 (0.20)	10.5 (0.35)	6.1 (0.19)	7.2 (0.17)	7.2 (0.63)	1.4 (0.14)	6.4 (0.15)	5.0 (0.12)
Tm	1.6 (0.03)	1.9 (0.05)	3.3 (0.11)	1.5 (0.06)	2.0 (0.05)	2.4 (0.24)	≤ LOD	1.5 (0.05)	1.4 (0.03)
Yb	19.0 (0.35)	19.4 (0.52)	38.6 (1.10)	13.7 (0.54)	20.7 (0.54)	28.7 (3.00)	2.4 (0.38)	13.5 (0.48)	14.5 (0.26)
Lu	3.0 (0.06)	3.0 (0.07)	6.3 (0.21)	2.1 (0.08)	3.2 (0.07)	4.5 (0.41)	≤ LOD	2.0 (0.09)	2.2 (0.05)
∑REE + Y	406.6 (2.6)	416.4 (6.3)	851.1 (23.1)	383.2 (17.1)	536.7 (10.3)	675.9 (38.9)	102.5 (4.4)	316.2 (3.8)	330.8 (1.9)
$(La/Lu)_{CN}$	3.49 (0.63)	2.40 (0.63)	3.21 (1.01)	3.64 (1.58)	3.61 (0.95)	3.75 (1.81)	5.18 (2.87)	2.17 (0.66)	2.67 (0.53)
$(La/Sm)_{CN}$	24.23 (6.10)	8.53 (2.41)	21.98 (6.90)	8.34 (3.69)	12.89 (3.65)	20.47 (9.54)	3.05 (1.24)	4.54 (1.27)	11.29 (2.71)
$(La/Y)_{CN}$	10.39 (1.69)	5.59 (1.51)	9.39 (2.94)	7.05 (3.01)	8.32 (2.21)	10.87 (5.16)	7.07 (3.36)	3.89 (1.06)	5.70 (0.99)
$Eu_A = Eu/Eu^*$	18.93 (1.54)	17.06 (1.03)	22.90 (1.38)	10.36 (0.77)	16.36 (0.94)	23.09 (2.69)	3.18 (0.50)	10.46 (0.65)	16.09 (1.18)
$Ce_A = Ce/Ce^*$	0.94 (0.04)	1.12 (0.09)	0.99 (0.12)	1.02 (0.24)	1.02 (0.09)	0.98 (0.24)	1.01 (0.21)	1.15 (0.09)	1.15 (0.05)

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TABLE C26. *(continued)*

Sample (ppm)	M1020_S_4	M1020_S_5	M1020_S_6	M1020_S_7	M1020_S_8	M1020_S_9	M1020_S_10	M1020_S_11	M1020_S_12
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	2.2 (0.3)	1.6 (0.2)	5.4 (0.6)	1.8 (0.3)	1.8 (0.3)	2.5 (0.3)	3.2 (0.2)	2.6 (0.3)	2.2 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	19 (38.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	257 (7.2)	240 (7.3)	209 (8.8)	83 (3.2)	146 (7.5)	104 (4.2)	511 (13.0)	418 (13.0)	304 (7.9)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	39.3 (0.6)	40.0 (0.6)	39.4 (0.6)	36.9 (0.7)	40.6 (0.7)	37.5 (0.6)	44.1 (0.7)	39.6 (0.5)	39.2 (0.7)
Y	179.9 (2.8)	201.7 (3.0)	158.0 (2.6)	64.1 (1.1)	120.9 (2.2)	97.9 (1.4)	224.4 (3.0)	270.5 (3.5)	187.6 (2.9)
Mo	647 (11.0)	552 (11.0)	729 (12.0)	595 (7.1)	513 (8.0)	609 (10.0)	732 (12.0)	692 (10.0)	658 (9.4)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	716000 (10000)	707000 (11000)	713000 (10000)	718000 (10000)	705000 (14000)	707000 (11000)	708000 (11000)	715000 (12000)	731000 (13000)
La	31.6 (0.33)	28.3 (0.49)	29.9 (0.58)	17.5 (0.32)	29.3 (0.44)	20.4 (0.31)	55.9 (0.77)	43.6 (0.60)	35.1 (0.57)
Ce	156.2 (2.40)	137.8 (2.30)	149.8 (2.60)	87.4 (1.40)	143.2 (2.30)	107.7 (1.70)	261.8 (3.40)	219.8 (3.90)	174.0 (2.70)
Pr	32.7 (0.51)	29.4 (0.52)	31.6 (0.55)	18.2 (0.31)	29.3 (0.44)	22.8 (0.33)	51.0 (0.52)	45.6 (0.73)	36.0 (0.62)
Nd	204.1 (3.10)	186.2 (3.00)	200.4 (3.00)	112.0 (1.80)	179.9 (3.00)	144.1 (1.90)	299.1 (3.90)	288.4 (4.20)	226.7 (3.50)
Sm	58.7 (1.20)	54.5 (0.98)	56.5 (1.10)	29.6 (0.65)	48.0 (0.96)	39.5 (0.66)	80.1 (1.20)	84.1 (1.50)	65.5 (0.93)
Eu	4.86 (0.10)	4.70 (0.13)	3.76 (0.09)	1.58 (0.05)	2.77 (0.07)	2.70 (0.07)	5.45 (0.12)	5.46 (0.13)	4.39 (0.09)
Gd	62.5 (1.10)	61.9 (1.20)	60.9 (0.77)	28.4 (0.61)	48.0 (1.00)	40.3 (0.80)	82.4 (1.30)	94.9 (1.50)	71.7 (1.30)
Tb	7.6 (0.14)	7.9 (0.16)	7.4 (0.10)	3.2 (0.07)	5.6 (0.11)	4.6 (0.07)	9.9 (0.18)	11.5 (0.19)	8.5 (0.18)
Dy	44.3 (0.77)	47.2 (1.00)	41.0 (0.64)	17.1 (0.39)	30.9 (0.66)	25.5 (0.42)	54.6 (0.84)	66.2 (1.10)	48.0 (0.76)
Ho	8.5 (0.13)	9.2 (0.19)	7.7 (0.14)	3.1 (0.07)	5.7 (0.12)	4.7 (0.07)	10.3 (0.19)	12.8 (0.21)	9.0 (0.16)
Er	21.2 (0.32)	23.4 (0.45)	18.4 (0.31)	7.5 (0.13)	14.3 (0.27)	11.4 (0.20)	25.9 (0.42)	31.7 (0.51)	21.9 (0.39)
Tm	2.2 (0.04)	2.5 (0.06)	1.8 (0.05)	0.8 (0.02)	1.5 (0.04)	1.2 (0.03)	2.7 (0.05)	3.3 (0.06)	2.3 (0.06)
Yb	11.2 (0.24)	12.8 (0.29)	8.9 (0.25)	4.0 (0.11)	7.7 (0.19)	5.6 (0.13)	13.8 (0.33)	17.0 (0.39)	11.0 (0.24)
Lu	1.6 (0.04)	1.8 (0.04)	1.2 (0.03)	0.5 (0.02)	1.1 (0.03)	0.8 (0.02)	1.9 (0.04)	2.4 (0.07)	1.6 (0.05)
∑REE + Y	827.1 (4.4)	809.2 (4.3)	777.4 (4.3)	395.0 (2.5)	668.1 (4.1)	529.2 (2.8)	1179.4 (5.6)	1197.3 (6.3)	903.3 (4.9)
$(La/Lu)_{CN}$	2.04 (0.38)	1.64 (0.33)	2.48 (0.52)	3.40 (0.82)	2.83 (0.59)	2.64 (0.56)	2.98 (0.57)	1.90 (0.39)	2.27 (0.49)
$(La/Sm)_{CN}$	0.34 (0.06)	0.33 (0.06)	0.33 (0.07)	0.37 (0.07)	0.38 (0.07)	0.32 (0.06)	0.44 (0.07)	0.32 (0.06)	0.34 (0.06)
$(La/Y)_{CN}$	1.17 (0.19)	0.93 (0.17)	1.26 (0.24)	1.81 (0.34)	1.61 (0.29)	1.39 (0.24)	1.66 (0.27)	1.07 (0.18)	1.24 (0.22)
$Eu_A = Eu/Eu^*$	0.24 (0.01)	0.24 (0.01)	0.19 (0.01)	0.16 (0.01)	0.17 (0.01)	0.20 (0.01)	0.20 (0.01)	0.18 (0.01)	0.19 (0.01)
$Ce_A = Ce/Ce^*$	1.03 (0.05)	1.01 (0.05)	1.03 (0.05)	1.04 (0.05)	1.05 (0.05)	1.04 (0.05)	1.07 (0.05)	1.04 (0.05)	1.04 (0.05)

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TABLE C25. *(continued)*

Sample (ppm)	CXXXX_B_S_15	CXXXX_B_S_16	CXXXX_B_S_17	CXXXX_B_S_18
Li	≤ LOD	2 (0.3)	2 (0.2)	3 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	6.8 (0.3)	10.9 (0.4)	18.5 (0.4)	18.3 (0.6)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	61.5 (0.7)	60.3 (1.0)	55.2 (0.7)	56.1 (0.7)
Y	17.7 (0.3)	48.5 (6.8)	101.9 (1.8)	103.6 (1.9)
Mo	305 (4.7)	219 (14.0)	100 (1.6)	110 (1.8)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	776700 (8500)	786000 (10000)	782000 (10000)	781000 (12000)
La	2.7 (0.07)	29.2 (3.80)	123.3 (7.70)	100.6 (3.10)
Ce	8.0 (0.15)	69.7 (8.50)	224.7 (7.90)	203.6 (5.50)
Pr	1.4 (0.04)	7.2 (0.81)	17.2 (0.43)	17.5 (0.40)
Nd	9.4 (0.21)	22.3 (2.40)	34.0 (0.90)	40.0 (0.80)
Sm	4.4 (0.14)	4.8 (0.37)	4.4 (0.14)	6.1 (0.16)
Eu	1.22 (0.04)	11.10 (1.50)	33.23 (0.45)	28.95 (0.57)
Gd	4.8 (0.15)	4.2 (0.28)	2.7 (0.12)	4.1 (0.16)
Tb	0.7 (0.02)	0.7 (0.06)	0.6 (0.02)	0.9 (0.02)
Dy	4.3 (0.13)	5.3 (0.55)	6.1 (0.17)	7.5 (0.19)
Ho	0.8 (0.03)	1.1 (0.12)	1.5 (0.05)	1.8 (0.05)
Er	1.8 (0.08)	4.2 (0.56)	7.8 (0.16)	8.4 (0.23)
Tm	≤ LOD	0.9 (0.15)	2.5 (0.06)	2.4 (0.06)
Yb	1.1 (0.06)	8.5 (1.50)	29.3 (0.64)	24.1 (0.79)
Lu	≤ LOD	1.2 (0.23)	4.6 (0.10)	3.7 (0.11)
∑REE + Y	58.6 (0.4)	219.1 (9.9)	593.8 (11.1)	553.1 (6.5)
$(La/Lu)_{CN}$	2.14 (0.65)	2.46 (1.38)	2.75 (0.80)	2.85 (0.70)
$(La/Sm)_{CN}$	0.38 (0.09)	3.78 (1.72)	17.68 (5.44)	10.42 (2.49)
$(La/Y)_{CN}$	1.00 (0.21)	4.00 (2.08)	8.04 (2.28)	6.45 (1.43)
Eu_A = Eu/Eu*	0.81 (0.05)	7.34 (1.28)	27.32 (1.63)	16.74 (0.91)
Ce_A = Ce/Ce*	0.96 (0.06)	1.12 (0.25)	1.04 (0.11)	1.08 (0.07)

TABLE C26. Castañeda de Llamuco, Chile (M1020).

Sample (ppm)	M1020_S_1	M1020_S_2	M1020_S_3
Li	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD
Mn	2.0 (0.3)	2.6 (0.3)	1.9 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD
As	138 (4.5)	77 (2.3)	256 (9.4)
Rb	≤ LOD	≤ LOD	≤ LOD
Sr	37.3 (0.5)	38.0 (0.6)	38.6 (0.6)
Y	90.3 (1.2)	93.7 (1.1)	175.5 (2.1)
Mo	610 (8.3)	468 (6.5)	801 (12.0)
Ag	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD
W	719000 (8800)	712600 (8900)	715200 (8600)
La	19.8 (0.28)	20.6 (0.26)	31.0 (0.38)
Ce	98.3 (1.30)	100.1 (1.20)	153.9 (1.80)
Pr	21.1 (0.33)	21.0 (0.25)	32.0 (0.35)
Nd	132.4 (2.00)	131.3 (1.80)	200.4 (2.60)
Sm	36.3 (0.72)	34.7 (0.55)	56.9 (0.82)
Eu	2.43 (0.06)	1.68 (0.05)	4.46 (0.08)
Gd	37.3 (0.63)	35.7 (0.63)	63.6 (0.80)
Tb	4.4 (0.10)	4.2 (0.08)	7.7 (0.09)
Dy	23.9 (0.42)	23.5 (0.36)	44.1 (0.72)
Ho	4.5 (0.07)	4.5 (0.09)	8.4 (0.13)
Er	10.3 (0.18)	11.1 (0.22)	20.1 (0.24)
Tm	1.1 (0.02)	1.2 (0.03)	2.1 (0.04)
Yb	5.0 (0.14)	5.9 (0.14)	10.3 (0.23)
Lu	0.7 (0.03)	0.8 (0.03)	1.5 (0.03)
∑REE + Y	487.7 (2.7)	489.9 (2.4)	811.9 (3.5)
$(La/Lu)_{CN}$	2.94 (0.67)	2.55 (0.53)	2.15 (0.40)
$(La/Sm)_{CN}$	0.34 (0.06)	0.37 (0.06)	0.34 (0.06)
$(La/Y)_{CN}$	1.46 (0.24)	1.46 (0.23)	1.17 (0.18)
Eu_A = Eu/Eu*	0.20 (0.01)	0.14 (0.01)	0.22 (0.01)
Ce_A = Ce/Ce*	1.02 (0.05)	1.03 (0.05)	1.04 (0.05)

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TABLE C26. *(continued)*

Sample (ppm)	M1020_S_13	M1020_S_14	M1020_S_15	M1020_S_16	M1020_S_17	M1020_S_18	M1020_S_19	M1020_S_20
Li	≤ LOD	≤ LOD	≤ LOD	3 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	22 (11.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	340 (210.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	2.0 (0.3)	1.7 (0.2)	1.9 (0.3)	161.0 (88.0)	10.0 (0.4)	9.6 (0.3)	10.3 (0.4)	9.4 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	330 (190.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	22 (16.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	247 (7.3)	268 (8.2)	171 (6.0)	106 (2.3)	87 (2.6)	86 (4.1)	88 (4.1)	97 (4.1)
Rb	≤ LOD	≤ LOD	≤ LOD	4.9 (3.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	39.7 (0.6)	37.5 (0.8)	35.2 (0.7)	51.8 (1.4)	55.6 (1.2)	52.1 (0.9)	51.4 (1.0)	53.7 (1.0)
Y	147.9 (2.2)	151.9 (2.5)	128.5 (2.3)	863.0 (29.0)	756.0 (12.0)	776.0 (12.0)	845.0 (13.0)	918.0 (16.0)
Mo	679 (13.0)	710 (13.0)	721 (14.0)	777 (14.0)	743 (12.0)	734 (15.0)	775 (13.0)	732 (16.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	720000 (11000)	727000 (11000)	727000 (16000)	725000 (13000)	721000 (13000)	719000 (11000)	720000 (13000)	721000 (11000)
La	31.0 (0.50)	28.5 (0.38)	19.9 (0.34)	27.4 (0.80)	29.0 (0.54)	25.2 (0.39)	27.7 (0.34)	28.6 (0.48)
Ce	149.1 (2.60)	139.4 (2.20)	104.5 (1.90)	153.4 (3.30)	156.6 (2.60)	142.4 (1.70)	155.8 (2.60)	162.7 (2.80)
Pr	31.3 (0.58)	30.2 (0.48)	22.9 (0.45)	39.5 (0.75)	39.1 (0.79)	36.3 (0.58)	40.0 (0.61)	41.7 (0.78)
Nd	193.6 (4.30)	191.7 (2.70)	152.1 (3.00)	311.8 (5.40)	301.3 (5.00)	285.3 (4.10)	311.9 (4.50)	336.1 (5.60)
Sm	56.9 (0.98)	57.0 (1.10)	45.7 (1.20)	168.6 (2.80)	158.1 (2.70)	153.7 (2.40)	167.9 (2.70)	182.5 (3.60)
Eu	3.32 (0.10)	3.35 (0.09)	2.89 (0.09)	8.52 (0.22)	8.13 (0.20)	8.01 (0.17)	8.46 (0.17)	8.98 (0.20)
Gd	58.4 (0.90)	60.0 (1.00)	50.0 (1.10)	236.0 (5.10)	212.8 (3.50)	215.6 (3.30)	231.0 (4.30)	253.6 (5.20)
Tb	7.0 (0.12)	7.1 (0.16)	5.9 (0.14)	34.2 (0.93)	30.5 (0.60)	31.4 (0.54)	34.1 (0.53)	37.4 (0.73)
Dy	38.6 (0.65)	39.9 (0.80)	32.7 (0.63)	214.5 (6.30)	187.9 (3.50)	194.4 (3.40)	211.5 (3.50)	232.3 (4.10)
Ho	7.2 (0.12)	7.5 (0.12)	6.1 (0.14)	40.2 (1.20)	35.5 (0.59)	36.5 (0.51)	40.0 (0.71)	43.8 (0.87)
Er	17.3 (0.32)	17.8 (0.38)	14.7 (0.31)	102.8 (4.10)	89.6 (1.20)	94.2 (1.40)	99.8 (1.70)	111.5 (2.00)
Tm	1.8 (0.04)	1.8 (0.06)	1.5 (0.04)	11.6 (0.38)	10.2 (0.16)	10.6 (0.15)	11.5 (0.18)	12.6 (0.21)
Yb	8.9 (0.20)	9.0 (0.21)	7.3 (0.21)	61.7 (1.90)	52.7 (0.69)	55.8 (0.80)	60.5 (0.89)	65.9 (1.10)
Lu	1.2 (0.04)	1.3 (0.03)	1.0 (0.03)	8.4 (0.25)	7.2 (0.16)	7.6 (0.12)	8.3 (0.14)	8.9 (0.16)
∑REE + Y	753.4 (5.3)	746.4 (3.9)	595.7 (4.0)	2281.6 (11.7)	2074.6 (8.2)	2073.0 (7.2)	2253.3 (8.4)	2444.7 (10.2)
$(La/Lu)_{CN}$	2.57 (0.57)	2.32 (0.46)	2.06 (0.47)	0.34 (0.08)	0.42 (0.08)	0.34 (0.06)	0.35 (0.06)	0.33 (0.06)
$(La/Sm)_{CN}$	0.34 (0.06)	0.31 (0.06)	0.27 (0.06)	0.10 (0.02)	0.11 (0.02)	0.10 (0.02)	0.10 (0.02)	0.10 (0.02)
$(La/Y)_{CN}$	1.39 (0.25)	1.25 (0.22)	1.03 (0.19)	0.21 (0.05)	0.25 (0.05)	0.22 (0.04)	0.22 (0.04)	0.21 (0.04)
Eu_A = Eu/Eu*	0.17 (0.01)	0.17 (0.01)	0.18 (0.01)	0.13 (0.01)	0.13 (0.01)	0.13 (0.01)	0.13 (0.01)	0.13 (0.01)
Ce_A = Ce/Ce*	1.02 (0.05)	1.00 (0.05)	1.01 (0.06)	0.91 (0.05)	0.92 (0.05)	0.92 (0.05)	0.91 (0.05)	0.91 (0.05)

TABLE C27. Tungstar, California, USA (M6258).

Sample (ppm)	M6258_S_2	M6258_S_3	M6258_S_4	M6258_S_5	M6258_S_6	M6258_S_7	M6258_S_8	M6258_S_9	M6258_S_10
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	4.7 (0.4)	22.4 (0.9)	7.4 (0.9)	1.6 (0.3)	5.1 (0.3)	2.3 (0.3)	1.4 (0.2)	6.5 (1.2)	5.1 (0.6)
Fe	36 (11.0)	168 (14.0)	13 (7.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	8 (2.1)	19 (0.8)	3 (1.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	6 (0.3)	8 (0.4)	6 (0.4)	3 (0.2)	3 (0.2)	5 (0.2)	3 (0.3)	10 (0.5)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	145.7 (3.8)	147.4 (2.8)	126.3 (2.6)	145.6 (1.9)	141.4 (2.4)	143.6 (2.6)	144.1 (2.1)	169.2 (3.1)	100.2 (1.6)
Y	4.2 (0.1)	3.1 (0.1)	5.5 (0.1)	0.5 (0.0)	0.7 (0.0)	1.3 (0.1)	0.7 (0.0)	1.8 (0.1)	1.2 (0.0)
Mo	6460 (150.0)	6480 (140.0)	6470 (140.0)	6590 (120.0)	6480 (110.0)	6410 (110.0)	6450 (110.0)	9410 (170.0)	6502 (96.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	671000 (12000)	683000 (13000)	687000 (12000)	686200 (9400)	695000 (12000)	679000 (11000)	699000 (11000)	697000 (10000)	709000 (13000)
La	1.9 (0.05)	1.6 (0.06)	2.6 (0.06)	0.9 (0.03)	1.0 (0.04)	1.3 (0.04)	1.3 (0.04)	5.4 (0.19)	4.0 (0.09)
Ce	0.7 (0.03)	0.6 (0.03)	1.1 (0.03)	0.3 (0.02)	0.3 (0.02)	0.4 (0.02)	0.5 (0.02)	2.6 (0.12)	3.3 (0.10)
Pr	0.3 (0.01)	0.2 (0.01)	0.5 (0.02)	≤ LOD	≤ LOD	0.1 (0.01)	≤ LOD	0.6 (0.03)	1.1 (0.04)
Nd	1.7 (0.07)	1.1 (0.10)	2.4 (0.08)	≤ LOD	≤ LOD	0.5 (0.05)	≤ LOD	2.9 (0.15)	6.2 (0.18)
Sm	≤ LOD	≤ LOD	0.5 (0.04)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.07)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.09 (0.01)	0.30 (0.02)
Gd	0.5 (0.04)	0.4 (0.05)	0.8 (0.05)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.04)	0.6 (0.06)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	0.5 (0.03)	≤ LOD	0.7 (0.03)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	0.3 (0.03)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	10.9 (0.1)	8.0 (0.1)	14.8 (0.1)	2.3 (1.0)	2.5 (0.1)	4.3 (0.1)	3.0 (0.1)	14.5 (0.3)	17.9 (1.0)
$(La/Lu)_{CN}$	17.67 (8.34)	20.29 (11.30)	20.39 (9.78)	n.d.	46.99 (35.37)	39.88 (26.24)	63.11 (47.00)	265.74 (199.05)	n.d.
$(La/Sm)_{CN}$	3.42 (1.31)	4.30 (1.95)	3.30 (1.07)	20.45 (13.09)	14.22 (8.14)	8.12 (3.77)	18.23 (10.02)	9.06 (3.32)	2.95 (0.93)
$(La/Y)_{CN}$	3.02 (0.71)	3.52 (0.98)	3.12 (0.63)	12.16 (3.69)	9.34 (2.87)	6.82 (1.81)	11.97 (3.35)	20.10 (5.31)	21.70 (5.32)
$Eu_A = Eu/Eu^*$	0.53 (0.10)	0.43 (0.12)	0.36 (0.06)	1.51 (0.81)	0.87 (0.43)	0.57 (0.20)	1.50 (0.75)	0.69 (0.13)	1.23 (0.17)
$Ce_A = Ce/Ce^*$	0.20 (0.01)	0.20 (0.02)	0.23 (0.01)	0.20 (0.02)	0.21 (0.02)	0.20 (0.02)	0.24 (0.02)	0.28 (0.02)	0.36 (0.02)

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TABLE C27. *(continued)*

Sample (ppm)	M6258_S_11	M6258_S_12	M6258_S_13	M6258_S_14	M6258_S_15	M6258_S_16	M6258_S_17	M6258_S_18	M6258_S_19
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	22.1 (5.3)	2.0 (0.2)	2.0 (0.2)	3.0 (0.2)	2.5 (0.3)	3.8 (0.4)	14.7 (0.4)	1.8 (0.2)	16.8 (0.5)
Fe	218 (56.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	11 (4.4)	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	12 (3.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	4 (0.3)	9 (0.4)	5 (0.3)	5 (0.3)	2 (0.2)	4 (0.2)	≤ LOD	3 (0.2)	2 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	158.1 (3.5)	139.1 (2.7)	168.2 (3.2)	126.5 (1.8)	118.5 (2.7)	131.5 (2.6)	69.7 (1.1)	140.1 (2.5)	64.6 (1.1)
Y	≤ LOD	1.5 (0.1)	≤ LOD	1.2 (0.1)	2.3 (0.1)	≤ LOD	6.5 (0.1)	≤ LOD	6.0 (0.1)
Mo	5491 (92.0)	6737 (98.0)	6410 (110.0)	6096 (94.0)	6570 (120.0)	5436 (92.0)	2807 (46.0)	5647 (88.0)	3018 (58.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	700000 (13000)	680900 (9600)	704000 (13000)	711000 (13000)	714000 (12000)	714000 (14000)	720000 (13000)	715000 (10000)	728000 (12000)
La	4.0 (0.09)	0.9 (0.02)	0.5 (0.02)	2.7 (0.06)	2.7 (0.07)	3.3 (0.06)	≤ LOD	3.9 (0.08)	0.2 (0.01)
Ce	9.8 (0.20)	0.3 (0.02)	0.2 (0.01)	5.9 (0.12)	1.4 (0.05)	8.6 (0.16)	0.2 (0.01)	9.2 (0.17)	0.3 (0.02)
Pr	1.5 (0.04)	0.1 (0.01)	≤ LOD	1.2 (0.04)	0.5 (0.02)	1.9 (0.05)	≤ LOD	1.6 (0.05)	≤ LOD
Nd	6.0 (0.17)	0.6 (0.04)	≤ LOD	6.1 (0.19)	2.3 (0.11)	9.7 (0.24)	0.7 (0.05)	7.4 (0.24)	0.8 (0.06)
Sm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.0 (0.07)	≤ LOD	0.5 (0.04)	≤ LOD
Eu	0.22 (0.02)	≤ LOD	≤ LOD	0.16 (0.01)	0.16 (0.02)	0.39 (0.02)	0.16 (0.01)	0.23 (0.02)	0.14 (0.01)
Gd	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (0.04)	0.3 (0.03)	0.7 (0.05)	≤ LOD	0.6 (0.05)
Tb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.05)	≤ LOD	0.9 (0.05)
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.03)	≤ LOD	0.6 (0.03)
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.4 (0.03)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	22.1 (1.8)	4.1 (0.1)	1.2 (1.7)	18.2 (0.2)	10.9 (0.2)	25.4 (1.8)	10.6 (0.1)	23.1 (1.0)	10.9 (0.1)
$(La/Lu)_{CN}$	n.d.	20.59 (12.51)	n.d.	116.87 (81.00)	310.04 (291.76)	n.d.	0.40 (0.20)	n.d.	0.50 (0.21)
$(La/Sm)_{CN}$	5.84 (1.97)	4.22 (1.87)	9.06 (5.53)	4.07 (1.42)	3.80 (1.32)	2.02 (0.60)	0.19 (0.08)	5.06 (1.68)	0.46 (0.20)
$(La/Y)_{CN}$	122.78 (42.69)	3.91 (1.01)	11.36 (3.84)	14.76 (3.76)	7.94 (1.89)	140.80 (49.20)	0.10 (0.04)	121.10 (38.62)	0.26 (0.07)
$Eu_A = Eu/Eu^*$	2.40 (0.46)	0.38 (0.12)	0.94 (0.54)	1.50 (0.28)	0.96 (0.15)	1.65 (0.23)	0.95 (0.13)	2.38 (0.45)	0.93 (0.15)
$Ce_A = Ce/Ce^*$	0.97 (0.05)	0.21 (0.02)	0.23 (0.02)	0.77 (0.04)	0.27 (0.02)	0.80 (0.04)	0.35 (0.05)	0.87 (0.05)	0.43 (0.05)

TABLE C28. Zinnwald – Cínovec, Germany (M6348).

Sample (ppm)	M6348_S_1	M6348_S_2	M6348_S_3	M6348_S_4	M6348_S_5	M6348_S_6	M6348_S_7	M6348_S_8	M6348_S_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	2.4 (0.2)	2.5 (0.3)	1.6 (0.3)	≤ LOD	2.7 (0.3)	1.9 (0.3)	3.6 (0.3)	3.5 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	3 (0.2)	3 (0.2)	≤ LOD	3 (0.2)	5 (0.3)	≤ LOD	≤ LOD	2 (0.2)	2 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	2022.0 (26.0)	2359.0 (36.0)	2263.0 (34.0)	2235.0 (33.0)	2376.0 (38.0)	2284.0 (29.0)	2229.0 (26.0)	2139.0 (33.0)	2179.0 (27.0)
Y	334.2 (4.3)	208.1 (6.5)	60.7 (0.9)	304.0 (5.5)	258.6 (4.1)	64.9 (1.0)	114.5 (2.4)	180.1 (3.2)	116.9 (1.8)
Mo	411 (5.6)	545 (10.0)	469 (8.1)	391 (6.2)	326 (5.3)	375 (4.5)	346 (5.5)	454 (7.8)	433 (7.4)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	642800 (9600)	640000 (11000)	635000 (11000)	639700 (9900)	647000 (11000)	649900 (9000)	645500 (9700)	647500 (8800)	644000 (9300)
La	112.8 (1.40)	146.8 (5.10)	186.0 (2.10)	155.9 (3.20)	85.4 (1.30)	147.4 (1.70)	105.6 (1.40)	140.7 (1.90)	134.5 (2.00)
Ce	421.2 (5.70)	398.0 (15.00)	185.3 (2.60)	486.5 (7.70)	399.3 (6.30)	199.8 (3.30)	212.0 (3.80)	372.4 (6.70)	303.4 (4.40)
Pr	55.5 (0.80)	46.2 (1.90)	9.5 (0.19)	49.8 (0.94)	68.7 (0.98)	13.1 (0.30)	20.7 (0.37)	39.1 (0.61)	29.7 (0.43)
Nd	222.2 (3.50)	170.5 (7.00)	22.1 (0.59)	149.7 (3.70)	339.9 (6.70)	31.7 (0.98)	71.9 (1.20)	134.0 (2.20)	98.1 (1.90)
Sm	46.7 (0.73)	33.7 (1.50)	3.8 (0.16)	22.6 (0.73)	90.6 (1.80)	4.3 (0.22)	14.1 (0.39)	24.3 (0.47)	16.7 (0.53)
Eu	31.52 (0.43)	24.33 (0.97)	12.70 (0.28)	55.20 (1.30)	49.66 (0.79)	6.13 (0.17)	12.64 (0.28)	18.89 (0.31)	12.61 (0.24)
Gd	39.4 (0.72)	28.2 (1.20)	3.2 (0.16)	18.1 (0.69)	77.5 (1.60)	3.3 (0.16)	12.2 (0.26)	19.8 (0.38)	13.1 (0.38)
Tb	6.1 (0.10)	4.3 (0.19)	0.4 (0.02)	3.0 (0.12)	11.2 (0.22)	0.5 (0.02)	1.8 (0.03)	3.0 (0.07)	2.0 (0.06)
Dy	39.3 (0.62)	27.0 (0.99)	2.8 (0.10)	22.2 (0.87)	63.4 (1.30)	3.7 (0.18)	12.0 (0.24)	19.2 (0.36)	12.6 (0.33)
Ho	7.4 (0.10)	4.9 (0.18)	0.5 (0.03)	4.4 (0.16)	9.9 (0.18)	0.8 (0.03)	2.2 (0.04)	3.6 (0.09)	2.4 (0.06)
Er	19.9 (0.30)	12.7 (0.46)	2.0 (0.06)	14.6 (0.36)	20.7 (0.44)	2.7 (0.09)	6.1 (0.14)	10.1 (0.25)	6.7 (0.15)
Tm	2.7 (0.05)	1.7 (0.06)	0.5 (0.02)	2.6 (0.06)	2.0 (0.05)	0.6 (0.02)	0.9 (0.03)	1.6 (0.04)	1.0 (0.03)
Yb	14.1 (0.26)	9.1 (0.26)	5.8 (0.15)	16.4 (0.33)	7.5 (0.19)	5.0 (0.11)	6.3 (0.18)	10.0 (0.21)	7.0 (0.20)
Lu	1.4 (0.04)	0.9 (0.02)	0.9 (0.02)	1.7 (0.05)	0.7 (0.02)	0.7 (0.02)	0.7 (0.03)	1.2 (0.03)	0.9 (0.03)
∑REE + Y	1354.4 (7.0)	1116.4 (17.6)	496.2 (3.4)	1306.8 (9.4)	1485.1 (9.8)	484.6 (3.9)	593.8 (4.3)	977.8 (7.4)	757.6 (5.3)
$(La/Lu)_{CN}$	8.29 (1.62)	16.56 (4.09)	21.28 (4.08)	9.40 (2.07)	13.58 (3.01)	22.34 (4.59)	14.60 (3.45)	12.55 (2.49)	16.21 (3.53)
$(La/Sm)_{CN}$	1.51 (0.25)	2.73 (0.77)	31.09 (7.22)	4.32 (0.99)	0.59 (0.11)	21.59 (5.42)	4.71 (0.95)	3.63 (0.66)	5.04 (1.09)
$(La/Y)_{CN}$	2.24 (0.36)	4.69 (1.20)	20.36 (3.31)	3.41 (0.67)	2.20 (0.39)	15.10 (2.48)	6.13 (1.13)	5.19 (0.92)	7.65 (1.33)
$Eu_A = Eu/Eu^*$	2.17 (0.08)	2.33 (0.18)	10.85 (0.79)	8.02 (0.48)	1.76 (0.07)	4.77 (0.40)	2.86 (0.14)	2.54 (0.10)	2.50 (0.14)
$Ce_A = Ce/Ce^*$	1.27 (0.06)	1.15 (0.09)	0.68 (0.03)	1.32 (0.06)	1.17 (0.06)	0.86 (0.04)	1.03 (0.05)	1.19 (0.05)	1.11 (0.05)

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TABLE C28. *(continued)*

Sample (ppm)	M6348_S_10	M6348_S_11	M6348_S_12	M6348_S_13	M6348_S_14	M6348_S_15	M6348_S_16	M6348_S_17	M6348_S_18
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.8 (0.3)	≤ LOD	2.6 (0.3)	2.9 (0.3)	6.1 (0.3)	6.1 (0.3)	≤ LOD	1.0 (0.2)	1.9 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	3 (0.3)	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.1)	4 (0.2)	2 (0.2)	2 (0.1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	2177.0 (18.0)	2112.0 (33.0)	2385.0 (40.0)	2271.0 (51.0)	2296.0 (52.0)	2161.0 (50.0)	1938.0 (41.0)	2092.0 (53.0)	1992.0 (41.0)
Y	120.5 (1.8)	241.2 (4.2)	158.6 (2.9)	145.1 (3.0)	80.7 (1.6)	122.5 (2.7)	341.2 (8.1)	184.6 (3.9)	219.3 (4.7)
Mo	424 (4.5)	338 (5.2)	405 (6.6)	524 (8.9)	2035 (43.0)	1543 (31.0)	345 (6.2)	389 (9.1)	401 (7.3)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	646900 (7700)	648000 (13000)	639000 (11000)	640000 (13000)	643000 (13000)	635000 (12000)	655000 (13000)	649000 (17000)	651000 (14000)
La	119.0 (1.40)	81.5 (1.20)	126.0 (1.70)	124.2 (1.70)	194.4 (2.80)	173.5 (3.30)	64.0 (1.10)	121.3 (2.20)	126.1 (2.40)
Ce	266.1 (3.90)	316.4 (5.10)	339.2 (5.60)	306.0 (5.50)	416.0 (7.60)	349.4 (6.10)	318.3 (6.20)	317.2 (7.20)	403.9 (7.70)
Pr	26.2 (0.41)	52.0 (1.00)	38.5 (0.70)	33.8 (0.61)	42.8 (0.82)	33.3 (0.69)	55.4 (1.20)	37.8 (0.95)	48.9 (1.20)
Nd	88.2 (1.40)	260.0 (5.80)	140.5 (2.60)	123.9 (3.10)	150.4 (3.10)	110.0 (2.40)	281.2 (7.00)	156.5 (4.10)	185.5 (5.20)
Sm	16.3 (0.30)	75.7 (1.70)	27.7 (0.69)	24.2 (0.66)	22.7 (0.50)	17.4 (0.44)	75.6 (1.90)	35.2 (0.86)	34.3 (1.20)
Eu	12.60 (0.21)	35.09 (0.67)	18.77 (0.41)	15.10 (0.44)	9.46 (0.27)	10.91 (0.23)	41.74 (0.99)	18.39 (0.44)	22.82 (0.66)
Gd	13.4 (0.28)	72.3 (1.50)	23.5 (0.55)	20.2 (0.49)	15.5 (0.38)	13.8 (0.35)	72.4 (1.80)	30.6 (0.74)	29.1 (1.20)
Tb	1.9 (0.04)	10.5 (0.20)	3.5 (0.09)	3.0 (0.08)	2.0 (0.06)	2.1 (0.05)	10.8 (0.27)	4.4 (0.10)	4.3 (0.17)
Dy	12.3 (0.22)	60.0 (1.20)	21.7 (0.46)	18.7 (0.44)	12.1 (0.30)	14.3 (0.32)	65.6 (1.50)	26.3 (0.63)	27.6 (1.10)
Ho	2.3 (0.04)	9.3 (0.19)	3.9 (0.07)	3.3 (0.07)	2.2 (0.06)	2.8 (0.06)	10.6 (0.21)	4.6 (0.10)	5.0 (0.16)
Er	6.6 (0.11)	19.6 (0.34)	10.1 (0.23)	8.7 (0.21)	6.0 (0.13)	8.4 (0.18)	24.8 (0.45)	11.5 (0.27)	13.7 (0.38)
Tm	1.0 (0.03)	2.0 (0.04)	1.3 (0.03)	1.2 (0.02)	0.9 (0.02)	1.3 (0.03)	2.7 (0.06)	1.5 (0.04)	1.9 (0.05)
Yb	6.9 (0.16)	8.9 (0.21)	7.6 (0.17)	7.2 (0.16)	5.5 (0.13)	9.0 (0.21)	11.6 (0.26)	8.6 (0.18)	10.0 (0.20)
Lu	0.8 (0.02)	0.8 (0.03)	0.8 (0.03)	0.8 (0.03)	0.7 (0.03)	1.1 (0.03)	1.0 (0.03)	0.9 (0.03)	1.1 (0.03)
∑REE + Y	694.1 (4.4)	1245.3 (8.3)	921.6 (6.5)	835.5 (6.7)	961.4 (8.7)	869.7 (7.4)	1376.9 (10.0)	959.4 (8.7)	1133.4 (9.9)
$(La/Lu)_{CN}$	15.48 (3.17)	10.07 (2.18)	16.19 (3.51)	15.95 (3.42)	29.43 (6.64)	16.33 (3.62)	6.50 (1.40)	13.67 (3.08)	12.42 (2.79)
$(La/Sm)_{CN}$	4.57 (0.79)	0.67 (0.13)	2.85 (0.56)	3.21 (0.65)	5.37 (1.03)	6.25 (1.32)	0.53 (0.11)	2.16 (0.45)	2.30 (0.54)
$(La/Y)_{CN}$	6.56 (1.07)	2.25 (0.40)	5.28 (0.94)	5.69 (1.05)	16.01 (2.96)	9.41 (1.91)	1.25 (0.25)	4.37 (0.87)	3.82 (0.77)
$Eu_A = Eu/Eu^*$	2.51 (0.10)	1.42 (0.06)	2.18 (0.11)	2.02 (0.11)	1.45 (0.07)	2.07 (0.10)	1.69 (0.08)	1.66 (0.08)	2.14 (0.14)
$Ce_A = Ce/Ce^*$	1.10 (0.05)	1.13 (0.05)	1.16 (0.05)	1.12 (0.05)	1.05 (0.05)	1.04 (0.05)	1.18 (0.06)	1.12 (0.06)	1.23 (0.06)

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TABLE C28. *(continued)*

Sample (ppm)	M6348_S_19	M6348_S_20
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	2.9 (0.3)	1.2 (0.3)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	2 (0.1)	3 (0.2)
Rb	≤ LOD	≤ LOD
Sr	2013.0 (41.0)	2061.0 (41.0)
Y	165.8 (3.0)	269.9 (5.3)
Mo	428 (7.7)	363 (6.7)
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	659000 (13000)	666000 (16000)
La	172.9 (2.20)	101.6 (1.80)
Ce	426.2 (5.90)	416.0 (10.00)
Pr	41.1 (0.66)	59.9 (2.00)
Nd	130.6 (2.90)	257.3 (9.30)
Sm	19.6 (0.49)	56.6 (2.00)
Eu	13.69 (0.27)	32.75 (0.95)
Gd	15.1 (0.43)	49.2 (1.90)
Tb	2.3 (0.06)	7.5 (0.24)
Dy	15.5 (0.37)	44.5 (1.20)
Ho	3.1 (0.06)	7.7 (0.20)
Er	9.0 (0.21)	18.7 (0.31)
Tm	1.4 (0.04)	2.2 (0.05)
Yb	9.0 (0.20)	10.3 (0.20)
Lu	1.0 (0.03)	0.9 (0.03)
∑REE + Y	1026.2 (7.0)	1335.1 (14.3)
$(La/Lu)_{CN}$	17.64 (3.67)	11.14 (2.43)
$(La/Sm)_{CN}$	5.54 (1.08)	1.13 (0.26)
$(La/Y)_{CN}$	6.93 (1.22)	2.50 (0.48)
Eu_A = Eu/Eu*	2.33 (0.12)	1.84 (0.12)
Ce_A = Ce/Ce*	1.18 (0.05)	1.25 (0.08)

TABLE C29. Zinnwald – Cínovec, Czech Republic (CMNMC 82045).

Sample (ppm)	CMNMC82045 _A_1	CMNMC82045 _A_2	CMNMC82045 _A_3	CMNMC82045_ A_4	CMNMC82045_ A_5
Li	≤ LOD	8 (11.0)	≤ LOD	≤ LOD	≤ LOD
B	30 (3.7)	36 (2.2)	30 (3.4)	30 (3.1)	33 (2.0)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	6 (12.0)	18 (19.0)	≤ LOD	16 (12.0)	13 (14.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1 (1.6)
Cr	4 (15.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	4.0 (11.0)	8.0 (10.0)	14.0 (13.0)	5.0 (15.0)	1.4 (8.9)
Fe	6 (9.1)	11 (28.0)	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	8 (12.0)	≤ LOD	≤ LOD
Cu	4 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	3 (2.5)	≤ LOD
As	432 (38.0)	482 (51.0)	900 (140.0)	1850 (350.0)	954 (79.0)
Rb	≤ LOD	≤ LOD	0.7 (0.7)	≤ LOD	≤ LOD
Sr	620.0 (42.0)	546.0 (85.0)	255.0 (45.0)	330.0 (36.0)	470.0 (100.0)
Y	4.7 (1.1)	14.6 (5.2)	3.5 (4.8)	5.6 (5.3)	10.2 (3.3)
Mo	710 (100.0)	2100 (1800.0)	9000 (1700.0)	18400 (3200.0)	11100 (1300.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	0.7 (1.7)	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	942000 (68000)	995000 (89000)	850000 (140000)	920000 (110000)	905000 (77000)
La	0.6 (0.18)	3.2 (0.88)	0.5 (0.46)	1.5 (0.94)	2.3 (0.49)
Ce	≤ LOD	9.5 (2.70)	0.9 (1.10)	≤ LOD	7.3 (1.80)
Pr	≤ LOD	0.9 (0.55)	≤ LOD	0.8 (0.60)	0.9 (0.28)
Nd	≤ LOD	4.7 (3.20)	≤ LOD	2.1 (1.90)	3.2 (1.20)
Sm	≤ LOD	1.2 (0.96)	≤ LOD	1.4 (1.30)	1.5 (0.78)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	≤ LOD	2.1 (2.00)	≤ LOD	1.2 (0.90)	1.9 (1.00)
Tb	≤ LOD	0.3 (0.19)	≤ LOD	0.4 (0.28)	0.5 (0.17)
Dy	0.7 (0.25)	3.1 (1.70)	≤ LOD	3.3 (2.40)	3.3 (0.97)
Ho	0.4 (0.14)	0.9 (0.53)	≤ LOD	0.8 (0.58)	1.0 (0.28)
Er	2.3 (0.63)	3.8 (1.40)	≤ LOD	3.7 (2.70)	4.8 (1.30)
Tm	1.0 (0.22)	1.3 (0.53)	≤ LOD	1.1 (0.79)	1.5 (0.46)
Yb	15.5 (2.50)	16.6 (1.80)	1.1 (0.78)	17.0 (12.00)	25.0 (6.50)
Lu	3.2 (0.44)	3.5 (0.48)	≤ LOD	3.8 (2.20)	4.3 (1.20)
∑REE + Y	30.5 (3.1)	65.6 (5.8)	7.9 (2.4)	48.8 (14.1)	67.6 (7.4)
$(La/Lu)_{CN}$	0.02 (0.01)	0.09 (0.06)	0.11 (0.13)	0.04 (0.05)	0.05 (0.04)
$(La/Sm)_{CN}$	0.97 (1.09)	1.65 (1.70)	0.95 (1.42)	0.68 (0.85)	0.96 (0.83)
$(La/Y)_{CN}$	0.83 (0.61)	1.45 (1.15)	0.95 (1.44)	1.82 (2.27)	1.47 (1.08)
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.24 (0.84)	1.36 (0.93)	0.95 (2.06)	1.38 (1.85)	1.26 (0.59)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _A_6	CMNMC82045 _A_7	CMNMC82045 _A_8	CMNMC82045 _A_9	CMNMC82045 _A_10	CMNMC82045 _A_11	CMNMC82045 _A_12	CMNMC82045_ A_13	CMNMC82045_ A_14
Li	≤ LOD	9 (8.3)	8 (7.0)	≤ LOD	5 (7.6)	≤ LOD	12 (9.6)	≤ LOD	≤ LOD
B	32 (2.8)	27 (6.0)	34 (2.0)	30 (4.6)	38 (2.5)	35 (3.1)	33 (1.8)	32 (6.0)	38 (3.4)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	56 (54.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	10 (30.0)	14 (16.0)	≤ LOD	2 (21.0)	14 (51.0)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	2 (2.0)	≤ LOD	≤ LOD	2 (2.1)	≤ LOD	≤ LOD
Cr	≤ LOD	2 (16.0)	2 (14.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (45.0)
Mn	≤ LOD	≤ LOD	≤ LOD	17.5 (9.0)	4.8 (8.0)	≤ LOD	≤ LOD	12.0 (32.0)	20.0 (17.0)
Fe	14 (18.0)	≤ LOD	≤ LOD	≤ LOD	11 (19.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	7 (20.0)	5 (9.1)	10 (10.0)	8 (13.0)	15 (10.0)	≤ LOD	7 (11.0)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	3 (5.6)	≤ LOD	≤ LOD	≤ LOD	5 (8.8)	≤ LOD
Zn	≤ LOD	3 (2.7)	≤ LOD	2 (4.6)	≤ LOD	2 (4.4)	≤ LOD	5 (7.7)	7 (4.8)
As	1260 (260.0)	730 (100.0)	517 (39.0)	557 (78.0)	633 (95.0)	730 (130.0)	1300 (180.0)	680 (210.0)	1240 (200.0)
Rb	1.1 (1.9)	0.9 (0.9)	≤ LOD	≤ LOD	1.4 (1.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	86.0 (13.0)	134.0 (30.0)	183.0 (32.0)	410.0 (88.0)	114.0 (15.0)	133.0 (20.0)	141.0 (19.0)	131.0 (31.0)	140.0 (12.0)
Y	133.9 (8.9)	55.0 (10.0)	68.0 (20.0)	19.0 (14.0)	66.0 (23.0)	45.0 (21.0)	6.5 (5.3)	≤ LOD	≤ LOD
Mo	48000 (10000.0)	21900 (4100.0)	25100 (6100.0)	4800 (3500.0)	25100 (5400.0)	29000 (5500.0)	10500 (3300.0)	5100 (1300.0)	7100 (1300.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	1.3 (1.9)	4.6 (4.3)	≤ LOD	17.0 (15.0)	2.8 (4.0)	≤ LOD	≤ LOD	0.8 (1.8)	≤ LOD
Ba	2 (2.0)	≤ LOD	≤ LOD	1 (2.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	940000 (210000)	890000 (110000)	874000 (55000)	970000 (130000)	990000 (140000)	913000 (94000)	932000 (95000)	770000 (150000)	895000 (83000)
La	11.2 (5.30)	18.9 (3.50)	12.7 (2.90)	8.0 (5.20)	14.6 (3.00)	13.9 (4.10)	1.0 (1.10)	≤ LOD	≤ LOD
Ce	53.0 (18.00)	48.5 (9.40)	42.0 (11.00)	18.0 (10.00)	≤ LOD	41.0 (15.00)	4.3 (3.90)	0.1 (0.19)	0.2 (0.32)
Pr	9.1 (1.60)	6.3 (1.50)	5.0 (1.20)	2.2 (1.40)	6.0 (1.90)	4.8 (2.00)	0.7 (0.65)	≤ LOD	0.3 (0.35)
Nd	42.0 (10.00)	26.0 (6.60)	21.9 (7.50)	12.2 (9.20)	27.6 (7.60)	24.0 (11.00)	2.5 (2.90)	≤ LOD	≤ LOD
Sm	32.0 (14.00)	9.8 (2.90)	9.0 (3.40)	4.2 (2.20)	10.6 (4.00)	9.6 (4.20)	0.8 (0.92)	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	27.0 (12.00)	7.4 (2.50)	7.1 (2.50)	4.4 (3.10)	10.5 (4.30)	6.7 (3.40)	1.0 (1.10)	≤ LOD	≤ LOD
Tb	4.4 (0.73)	1.6 (0.28)	1.6 (0.53)	1.1 (0.75)	2.1 (0.78)	1.5 (0.67)	0.3 (0.27)	≤ LOD	≤ LOD
Dy	33.2 (9.80)	11.6 (2.00)	10.4 (2.50)	7.2 (3.00)	12.0 (4.10)	10.5 (5.50)	1.3 (1.20)	≤ LOD	≤ LOD
Ho	7.7 (3.40)	2.8 (0.65)	2.3 (0.52)	1.5 (0.69)	2.7 (0.79)	2.2 (1.20)	0.3 (0.25)	≤ LOD	≤ LOD
Er	32.0 (13.00)	10.2 (2.90)	10.1 (2.20)	8.7 (4.60)	11.5 (4.10)	7.6 (4.20)	1.2 (1.10)	≤ LOD	≤ LOD
Tm	5.4 (1.60)	2.6 (0.52)	2.8 (0.46)	2.3 (0.85)	3.7 (1.20)	2.4 (1.00)	≤ LOD	≤ LOD	≤ LOD
Yb	72.0 (31.00)	33.1 (6.10)	29.5 (5.60)	27.7 (9.20)	36.0 (11.00)	27.0 (12.00)	2.8 (2.60)	≤ LOD	≤ LOD
Lu	9.3 (3.10)	4.7 (0.78)	5.0 (0.73)	6.0 (2.60)	5.7 (1.70)	4.0 (1.20)	0.6 (0.41)	≤ LOD	≤ LOD
∑REE + Y	472.2 (45.2)	238.4 (14.6)	227.3 (15.8)	122.6 (18.8)	250.3 (18.3)	200.2 (24.4)	23.5 (6.2)	0.8 (2.9)	1.2 (2.5)
$(La/Lu)_{CN}$	0.12 (0.11)	0.42 (0.25)	0.26 (0.16)	0.14 (0.14)	0.27 (0.19)	0.36 (0.28)	0.19 (0.26)	n.d.	0.05 (0.07)
$(La/Sm)_{CN}$	0.22 (0.21)	1.21 (0.84)	0.88 (0.69)	1.19 (1.29)	0.86 (0.66)	0.91 (0.78)	0.76 (1.12)	n.d.	n.d.
$(La/Y)_{CN}$	0.56 (0.41)	2.28 (1.38)	1.24 (0.90)	2.80 (3.30)	1.47 (1.09)	2.05 (1.79)	1.02 (1.42)	n.d.	n.d.
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.17 (0.60)	1.06 (0.38)	1.26 (0.54)	1.02 (1.10)	1.06 (0.46)	1.20 (0.75)	1.20 (2.06)	n.d.	0.16 (0.48)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _A_15	CMNMC82045 _A_16	CMNMC82045 _A_17	CMNMC82045 _A_18	CMNMC82045 _A_19	CMNMC82045 _A_20	CMNMC82045 _A_21	CMNMC82045_ A_22	CMNMC82045_ A_23
Li	≤ LOD	10 (14.0)	≤ LOD	≤ LOD	25 (27.0)	≤ LOD	≤ LOD	9 (13.0)	≤ LOD
B	31 (5.9)	33 (5.3)	33 (3.9)	33 (3.4)	41 (8.8)	35 (3.8)	33 (3.9)	37 (4.7)	36 (3.2)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	28 (25.0)	14 (20.0)	≤ LOD	43 (25.0)	≤ LOD	8 (20.0)	≤ LOD	16 (23.0)	13 (22.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	28 (46.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	4.0 (17.0)	≤ LOD	≤ LOD	≤ LOD	8.0 (30.0)	≤ LOD	≤ LOD	8.8 (7.7)	5.3 (7.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	1.2 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	10 (14.0)	≤ LOD	≤ LOD	4 (25.0)	4 (20.0)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	2 (4.0)	≤ LOD	4 (20.0)	≤ LOD	≤ LOD	≤ LOD	5 (5.4)
Zn	3 (4.5)	3 (3.5)	4 (4.5)	≤ LOD	≤ LOD	3 (4.0)	≤ LOD	≤ LOD	≤ LOD
As	2230 (290.0)	1370 (270.0)	746 (91.0)	960 (140.0)	2100 (1900.0)	1030 (180.0)	686 (64.0)	920 (150.0)	1050 (120.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.3 (0.8)	≤ LOD	0.7 (1.2)	≤ LOD
Sr	90.0 (12.0)	106.0 (18.0)	115.0 (19.0)	154.0 (20.0)	174.0 (51.0)	169.0 (19.0)	187.0 (15.0)	259.0 (70.0)	538.0 (71.0)
Y	40.3 (7.8)	17.0 (12.0)	0.5 (0.4)	0.5 (0.3)	3.4 (4.1)	4.4 (0.8)	2.9 (0.8)	3.6 (1.2)	6.6 (1.1)
Mo	31400 (5000.0)	18100 (4600.0)	10200 (1600.0)	12200 (3500.0)	11300 (4500.0)	12700 (2300.0)	6590 (380.0)	8100 (1600.0)	10500 (1000.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	0.6 (1.1)	0.5 (1.0)	0.5 (0.9)	0.9 (1.0)	0.5 (0.6)	≤ LOD	0.5 (1.3)	0.5 (1.2)
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	860000 (200000)	820000 (150000)	860000 (110000)	930000 (110000)	980000 (110000)	970000 (180000)	952000 (99000)	960000 (100000)	870000 (160000)
La	8.5 (3.00)	2.5 (1.70)	≤ LOD	0.3 (0.17)	0.7 (0.43)	0.4 (0.24)	0.4 (0.19)	0.6 (0.34)	0.9 (0.24)
Ce	38.9 (9.30)	10.6 (7.20)	0.3 (0.17)	0.3 (0.14)	2.2 (0.91)	2.2 (0.73)	1.1 (0.53)	1.1 (0.41)	3.7 (0.94)
Pr	4.2 (0.73)	1.4 (0.82)	≤ LOD	≤ LOD	0.5 (0.37)	0.3 (0.17)	0.3 (0.20)	0.2 (0.11)	0.5 (0.19)
Nd	17.6 (5.00)	4.2 (3.20)	≤ LOD	≤ LOD	≤ LOD	1.7 (1.10)	0.6 (0.45)	≤ LOD	1.8 (0.96)
Sm	6.0 (1.90)	1.1 (1.00)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.50)	0.5 (0.45)	0.7 (0.97)	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	5.8 (3.00)	1.1 (1.10)	≤ LOD	≤ LOD	0.5 (1.00)	≤ LOD	0.5 (0.44)	≤ LOD	0.6 (0.61)
Tb	1.5 (0.43)	0.5 (0.44)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.2 (0.12)	≤ LOD	0.2 (0.15)
Dy	10.5 (2.20)	4.2 (2.70)	≤ LOD	≤ LOD	0.7 (0.65)	1.0 (0.54)	1.6 (0.60)	1.8 (1.00)	1.7 (0.87)
Ho	3.2 (0.57)	1.2 (1.10)	≤ LOD	≤ LOD	0.8 (0.37)	≤ LOD	0.4 (0.15)	0.4 (0.11)	0.6 (0.17)
Er	16.6 (3.90)	6.0 (3.90)	0.7 (0.68)	≤ LOD	2.3 (2.90)	1.9 (0.51)	2.4 (0.58)	2.3 (0.77)	4.5 (1.10)
Tm	5.8 (1.30)	2.8 (2.00)	≤ LOD	≤ LOD	1.2 (0.96)	1.0 (0.51)	0.9 (0.29)	0.9 (0.48)	1.9 (0.56)
Yb	74.0 (15.00)	23.0 (17.00)	1.8 (0.83)	2.7 (1.00)	10.7 (5.00)	13.5 (3.20)	11.9 (2.30)	13.2 (3.70)	26.6 (7.00)
Lu	14.9 (2.90)	6.9 (4.80)	0.5 (0.12)	0.7 (0.29)	1.7 (0.17)	2.8 (0.62)	2.4 (0.48)	2.5 (0.40)	5.3 (1.30)
∑REE + Y	247.8 (19.7)	82.5 (20.2)	4.1 (2.7)	5.1 (2.3)	24.5 (6.4)	29.9 (4.1)	26.1 (2.9)	27.8 (4.4)	55.2 (7.5)
$(La/Lu)_{CN}$	0.06 (0.04)	0.04 (0.04)	0.04 (0.04)	0.04 (0.04)	0.04 (0.04)	0.02 (0.01)	0.02 (0.01)	0.03 (0.02)	0.02 (0.01)
$(La/Sm)_{CN}$	0.89 (0.73)	1.42 (1.80)	n.d.	n.d.	n.d.	0.54 (0.67)	0.49 (0.57)	0.53 (0.73)	3.10 (4.66)
$(La/Y)_{CN}$	1.40 (1.04)	0.98 (1.15)	2.44 (2.95)	3.91 (4.09)	1.29 (1.76)	0.66 (0.56)	0.93 (0.79)	1.16 (1.09)	0.95 (0.62)
Eu_A = Eu/Eu*	0.04 (0.06)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.55 (0.68)	1.36 (1.53)	1.17 (1.84)	0.67 (0.85)	0.85 (0.97)	1.43 (1.32)	0.74 (0.83)	0.85 (0.80)	1.21 (0.65)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045_A_24	CMNMC82045_A_25	CMNMC82045_A_26	CMNMC82045_A_27	CMNMC82045_A_28	CMNMC82045_A_29	CMNMC82045_A_30	CMNMC82045_A_31	CMNMC82045_A_32
Li	≤ LOD	≤ LOD	25 (16.0)	10 (21.0)	14 (12.0)	≤ LOD	4 (6.4)	≤ LOD	≤ LOD
B	36 (6.4)	38 (2.0)	35 (5.5)	34 (8.4)	31 (3.7)	35 (3.5)	35 (2.8)	37 (2.4)	32 (8.6)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	23 (10.0)	≤ LOD	18 (37.0)	≤ LOD	≤ LOD	18 (29.0)	12 (15.0)	≤ LOD	≤ LOD
V	4 (1.3)	2 (2.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	2 (30.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	9.0 (22.0)	4.8 (8.0)	2.4 (7.5)	7.0 (10.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	10 (13.0)	4 (15.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	5 (7.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	2 (9.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1010 (180.0)	1350 (840.0)	780 (100.0)	1280 (950.0)	790 (100.0)	793 (67.0)	763 (48.0)	966 (65.0)	1420 (630.0)
Rb	1.1 (1.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	650.0 (130.0)	531.0 (41.0)	447.0 (66.0)	570.0 (180.0)	403.0 (45.0)	522.0 (51.0)	520.0 (45.0)	548.0 (39.0)	530.0 (110.0)
Y	7.9 (1.1)	5.9 (0.9)	6.3 (1.2)	12.2 (2.2)	5.4 (0.9)	6.9 (2.0)	3.7 (0.6)	3.5 (0.6)	2.7 (1.4)
Mo	11700 (2200.0)	10100 (1200.0)	9600 (1400.0)	9400 (1400.0)	8670 (940.0)	7510 (650.0)	7480 (710.0)	6160 (640.0)	5400 (1200.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	0.6 (2.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.9 (1.1)
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	1100000 (220000)	1020000 (180000)	1050000 (220000)	940000 (170000)	830000 (100000)	950000 (130000)	979000 (61000)	938000 (61000)	830000 (150000)
La	1.6 (0.63)	1.4 (0.42)	1.1 (0.47)	1.2 (0.52)	0.7 (0.17)	0.5 (0.20)	0.4 (0.13)	0.4 (0.19)	0.5 (0.36)
Ce	4.2 (0.80)	3.2 (1.40)	3.0 (0.80)	2.6 (1.30)	2.3 (0.63)	1.7 (0.50)	1.4 (0.24)	1.3 (0.35)	0.8 (0.48)
Pr	0.5 (0.24)	0.3 (0.13)	0.5 (0.16)	0.3 (0.25)	0.4 (0.13)	0.2 (0.13)	≤ LOD	≤ LOD	0.1 (0.21)
Nd	2.3 (1.50)	1.0 (1.30)	1.3 (0.62)	3.1 (1.70)	2.1 (1.10)	0.7 (0.61)	0.6 (0.41)	≤ LOD	≤ LOD
Sm	1.2 (0.75)	1.2 (0.78)	0.9 (0.60)	2.9 (2.00)	≤ LOD	0.7 (0.54)	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	≤ LOD	0.7 (1.30)	0.5 (0.63)	1.5 (1.30)	0.5 (0.46)	1.6 (1.10)	0.5 (0.35)	0.3 (0.31)	≤ LOD
Tb	0.4 (0.15)	≤ LOD	0.3 (0.21)	1.4 (1.10)	0.4 (0.19)	0.8 (0.45)	≤ LOD	0.2 (0.07)	≤ LOD
Dy	3.8 (2.00)	4.4 (1.50)	3.1 (1.20)	10.2 (4.30)	3.8 (1.00)	5.4 (1.80)	2.3 (0.57)	2.8 (0.88)	3.7 (1.80)
Ho	1.1 (0.36)	1.0 (0.32)	1.2 (0.28)	1.5 (0.41)	1.0 (0.39)	1.6 (0.66)	0.7 (0.18)	0.7 (0.22)	1.0 (0.32)
Er	6.2 (1.40)	7.4 (1.20)	5.4 (1.20)	8.2 (5.00)	5.4 (1.20)	7.1 (1.60)	4.6 (0.66)	4.4 (0.66)	2.9 (0.59)
Tm	2.2 (0.58)	2.3 (1.60)	1.8 (0.17)	2.2 (0.53)	2.0 (0.25)	2.1 (0.41)	1.5 (0.34)	1.7 (0.20)	1.4 (0.47)
Yb	32.0 (6.50)	35.3 (6.40)	31.1 (7.40)	29.3 (3.90)	26.8 (4.60)	32.2 (5.70)	23.3 (2.70)	21.9 (2.90)	17.5 (3.50)
Lu	6.4 (1.20)	5.9 (0.53)	5.5 (0.91)	4.6 (1.20)	4.7 (1.00)	4.8 (0.84)	3.9 (0.54)	4.0 (0.42)	3.5 (0.79)
∑REE + Y	70.0 (7.4)	70.0 (7.4)	61.9 (7.9)	81.1 (8.6)	56.0 (5.3)	66.3 (6.6)	43.3 (3.2)	41.7 (3.4)	34.3 (4.6)
$(La/Lu)_{CN}$	0.03 (0.02)	0.02 (0.02)	0.02 (0.02)	0.03 (0.02)	0.02 (0.01)	0.01 (0.01)	n.d.	n.d.	0.01 (0.01)
$(La/Sm)_{CN}$	0.81 (0.81)	0.73 (0.72)	0.72 (0.75)	0.25 (0.27)	1.10 (1.25)	0.41 (0.45)	0.58 (0.65)	0.95 (1.31)	n.d.
$(La/Y)_{CN}$	1.34 (0.98)	1.51 (1.02)	1.13 (0.90)	0.63 (0.50)	0.86 (0.54)	0.45 (0.38)	0.63 (0.46)	0.66 (0.56)	1.21 (1.35)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	1.13 (0.73)	1.19 (0.81)	1.03 (0.64)	1.03 (1.02)	1.05 (0.55)	1.21 (0.96)	1.73 (1.20)	1.67 (1.49)	0.73 (1.21)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _A_33	CMNMC82045 _A_34	CMNMC82045 _A_35	CMNMC82045 _B_1	CMNMC82045 _B_2	CMNMC82045 _B_3	CMNMC82045 _B_4	CMNMC82045_ B_5	CMNMC82045_ B_6
Li	10 (11.0)	≤ LOD	≤ LOD	6 (13.0)	8 (9.0)	≤ LOD	≤ LOD	≤ LOD	4 (6.0)
B	34 (4.1)	32 (3.8)	≤ LOD	≤ LOD	37 (3.7)	38 (3.3)	35 (3.8)	39 (5.6)	41 (4.6)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	4 (16.0)	18 (17.0)	10 (16.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	19 (28.0)
V	2 (1.7)	2 (3.2)	2 (3.8)	2 (2.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	13 (22.0)	≤ LOD	≤ LOD	12 (25.0)	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	5.0 (15.0)	9.0 (41.0)	1.0 (12.0)	≤ LOD	≤ LOD	13.0 (13.0)	≤ LOD
Fe	≤ LOD	7 (32.0)	≤ LOD	54 (34.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.2 (1.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	4 (15.0)	7 (11.0)	2 (11.0)	17 (34.0)	≤ LOD	≤ LOD	10 (14.0)	≤ LOD	≤ LOD
Cu	7 (3.0)	≤ LOD	≤ LOD	3 (4.4)	≤ LOD	≤ LOD	3 (4.5)	≤ LOD	4 (2.9)
Zn	≤ LOD	≤ LOD	4 (7.1)	3 (4.2)	2 (3.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1470 (190.0)	1830 (140.0)	2320 (700.0)	310 (120.0)	178 (22.0)	286 (53.0)	303 (30.0)	383 (54.0)	376 (34.0)
Rb	≤ LOD	≤ LOD	≤ LOD	2.5 (3.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	641.0 (66.0)	573.0 (49.0)	530.0 (130.0)	304.0 (74.0)	262.0 (39.0)	368.0 (43.0)	442.0 (51.0)	620.0 (110.0)	599.0 (65.0)
Y	3.7 (1.3)	5.3 (1.0)	4.1 (1.4)	11.0 (11.0)	8.5 (6.3)	1.1 (0.3)	0.7 (0.4)	1.4 (0.4)	2.9 (1.0)
Mo	8540 (780.0)	15800 (1600.0)	12800 (3300.0)	520 (220.0)	608 (62.0)	860 (110.0)	1420 (130.0)	2010 (380.0)	2760 (350.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	1.1 (1.2)	≤ LOD	≤ LOD	1.2 (0.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	2 (4.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	970000 (130000)	970000 (160000)	800000 (340000)	1130000 (410000)	1020000 (110000)	913000 (90000)	1072000 (86000)	1020000 (130000)	942000 (92000)
La	1.0 (0.31)	1.8 (0.73)	1.0 (0.80)	0.3 (0.29)	≤ LOD	0.2 (0.15)	0.3 (0.26)	0.3 (0.27)	0.3 (0.10)
Ce	1.6 (0.52)	3.1 (0.30)	2.1 (0.43)	0.8 (1.20)	0.4 (0.31)	0.7 (0.26)	0.7 (0.23)	0.6 (0.40)	0.5 (0.31)
Pr	0.2 (0.08)	0.4 (0.19)	0.3 (0.29)	≤ LOD	0.2 (0.13)	0.2 (0.13)	≤ LOD	≤ LOD	≤ LOD
Nd	0.8 (0.81)	1.9 (0.86)	1.9 (2.30)	1.3 (1.60)	1.7 (1.20)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sm	≤ LOD	0.7 (0.53)	≤ LOD	2.6 (4.40)	5.9 (5.10)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	≤ LOD	1.0 (0.73)	0.6 (0.74)	2.2 (2.50)	1.7 (1.70)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tb	0.2 (0.10)	0.2 (0.17)	0.4 (0.18)	0.9 (1.10)	0.8 (0.68)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Dy	3.4 (1.10)	2.4 (0.43)	3.6 (2.20)	6.9 (6.00)	4.7 (4.00)	≤ LOD	≤ LOD	0.4 (0.30)	1.0 (0.38)
Ho	0.9 (0.29)	0.8 (0.26)	1.2 (0.92)	0.6 (0.68)	1.0 (0.91)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	4.4 (0.66)	3.8 (1.10)	3.9 (1.40)	3.3 (2.70)	2.9 (2.40)	≤ LOD	0.5 (0.29)	0.5 (0.35)	1.9 (0.63)
Tm	1.5 (0.48)	1.8 (0.55)	1.7 (0.86)	0.5 (0.24)	0.5 (0.32)	≤ LOD	≤ LOD	≤ LOD	0.6 (0.15)
Yb	21.0 (2.60)	21.0 (2.40)	25.0 (13.00)	6.4 (8.60)	2.9 (2.30)	0.5 (0.28)	0.3 (0.31)	2.9 (1.40)	10.6 (1.80)
Lu	4.7 (0.47)	3.9 (0.89)	4.7 (2.30)	0.7 (0.50)	≤ LOD	≤ LOD	≤ LOD	0.9 (0.49)	2.3 (0.70)
∑REE + Y	43.5 (3.5)	48.0 (3.4)	50.9 (13.8)	37.6 (12.2)	31.6 (7.8)	3.6 (2.1)	3.0 (2.3)	7.8 (2.5)	20.4 (3.1)
$(La/Lu)_{CN}$	0.02 (0.01)	0.05 (0.04)	0.02 (0.03)	0.05 (0.06)	n.d.	n.d.	0.35 (0.49)	0.04 (0.05)	0.01 (0.01)
$(La/Sm)_{CN}$	n.d.	1.68 (1.85)	1.46 (2.11)	0.07 (0.12)	n.d.	1.10 (1.81)	n.d.	n.d.	n.d.
$(La/Y)_{CN}$	1.74 (1.43)	2.22 (1.72)	1.62 (1.73)	0.19 (0.26)	n.d.	1.32 (1.34)	2.93 (3.56)	1.67 (1.74)	0.60 (0.51)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.78 (0.45)	0.88 (0.57)	0.99 (1.34)	1.14 (2.36)	n.d.	0.77 (0.93)	1.05 (1.30)	0.95 (1.46)	0.72 (0.71)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _B_7	CMNMC82045 _B_8	CMNMC82045 _B_9	CMNMC82045 _B_10	CMNMC82045 _B_11	CMNMC82045 _B_12	CMNMC82045 _B_13	CMNMC82045_ B_14	CMNMC82045_ B_15
Li	≤ LOD	≤ LOD	≤ LOD	2 (2.4)	≤ LOD	≤ LOD	9 (19.0)	≤ LOD	3 (5.6)
B	40 (4.2)	35 (5.1)	37 (2.7)	36 (2.3)	42 (7.3)	40 (9.6)	31 (4.2)	41 (2.6)	36 (3.3)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	52 (41.0)	≤ LOD	≤ LOD	≤ LOD	34 (25.0)
Ti	20 (16.0)	30 (11.0)	≤ LOD	≤ LOD	≤ LOD	5 (40.0)	10 (10.0)	5 (15.0)	4 (14.0)
V	≤ LOD	1 (2.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	13.0 (11.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	11.0 (18.0)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	0.8 (1.2)	≤ LOD	≤ LOD	≤ LOD	1.2 (1.7)	≤ LOD	1.1 (1.0)
Ni	9 (20.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	13 (7.9)
Cu	3 (7.6)	5 (4.4)	≤ LOD	≤ LOD	≤ LOD	7 (4.2)	4 (9.9)	≤ LOD	3 (3.3)
Zn	4 (7.8)	4 (2.6)	≤ LOD	≤ LOD	≤ LOD	3 (3.0)	≤ LOD	≤ LOD	2 (2.5)
As	445 (76.0)	285 (72.0)	672 (86.0)	369 (22.0)	680 (450.0)	323 (45.0)	620 (650.0)	424 (60.0)	428 (38.0)
Rb	≤ LOD	≤ LOD	0.9 (1.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.7 (0.6)	≤ LOD
Sr	493.0 (36.0)	533.0 (87.0)	494.0 (57.0)	458.0 (28.0)	650.0 (200.0)	460.0 (110.0)	457.0 (38.0)	403.0 (91.0)	90.0 (12.0)
Y	4.1 (1.2)	8.1 (3.7)	3.3 (1.0)	4.5 (1.1)	3.0 (1.8)	3.4 (1.1)	2.0 (1.7)	9.5 (2.4)	21.0 (10.0)
Mo	3760 (860.0)	1470 (610.0)	4270 (990.0)	1140 (120.0)	682 (98.0)	680 (150.0)	682 (84.0)	1270 (410.0)	5600 (2200.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	1.8 (2.4)	≤ LOD	0.6 (1.0)	≤ LOD	≤ LOD	≤ LOD	1.2 (1.6)	≤ LOD	0.6 (1.0)
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1 (2.5)	≤ LOD	≤ LOD
W	900000 (130000)	940000 (130000)	957000 (84000)	944000 (57000)	1040000 (180000)	1090000 (190000)	1057000 (93000)	1027000 (71000)	1010000 (110000)
La	≤ LOD	1.7 (0.55)	0.5 (0.28)	0.2 (0.10)	1.2 (0.34)	0.7 (0.63)	0.3 (0.02)	2.6 (0.84)	3.8 (2.40)
Ce	0.8 (0.27)	2.7 (0.61)	1.2 (0.41)	0.6 (0.18)	1.4 (0.31)	1.4 (0.73)	0.9 (0.38)	5.7 (1.50)	16.0 (7.90)
Pr	0.2 (0.15)	0.3 (0.28)	0.2 (0.11)	≤ LOD	0.2 (0.22)	0.3 (0.18)	≤ LOD	0.8 (0.24)	1.5 (0.57)
Nd	≤ LOD	2.2 (0.97)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.8 (0.84)	5.5 (2.70)
Sm	0.6 (0.74)	1.4 (1.00)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (0.38)	2.2 (1.40)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	1.2 (2.50)	0.8 (0.57)	≤ LOD	0.6 (0.44)	≤ LOD	≤ LOD	≤ LOD	0.7 (0.37)	3.0 (1.50)
Tb	0.4 (0.38)	0.6 (0.39)	≤ LOD	0.2 (0.12)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (0.32)
Dy	1.7 (1.10)	4.9 (2.70)	1.4 (0.63)	1.8 (0.78)	0.9 (0.67)	≤ LOD	0.7 (0.77)	1.6 (0.62)	5.2 (2.60)
Ho	0.4 (0.49)	0.9 (0.70)	0.5 (0.17)	0.6 (0.18)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.22)	1.4 (0.49)
Er	1.6 (1.10)	3.6 (1.80)	3.3 (0.94)	2.6 (0.64)	1.6 (0.80)	1.9 (1.30)	0.9 (0.96)	2.6 (0.66)	8.9 (2.90)
Tm	1.3 (0.71)	1.0 (0.51)	1.2 (0.53)	0.9 (0.19)	1.2 (0.44)	0.5 (0.12)	≤ LOD	1.0 (0.21)	2.5 (0.87)
Yb	9.3 (3.00)	9.1 (5.10)	20.8 (6.90)	16.1 (2.50)	15.3 (7.20)	12.2 (1.60)	9.4 (3.10)	16.0 (3.70)	29.9 (8.80)
Lu	2.2 (0.60)	2.5 (1.20)	4.7 (1.30)	3.4 (0.43)	3.1 (1.50)	2.5 (0.44)	1.8 (0.38)	3.1 (0.61)	5.8 (1.30)
∑REE + Y	24.2 (4.6)	39.8 (6.5)	37.5 (7.3)	32.4 (3.0)	28.1 (7.7)	23.2 (3.3)	16.8 (3.9)	46.6 (4.5)	107.3 (13.3)
$(La/Lu)_{CN}$	n.d.	0.07 (0.06)	0.01 (0.01)	n.d.	0.04 (0.04)	0.03 (0.03)	0.01 (0.01)	0.09 (0.06)	0.07 (0.06)
$(La/Sm)_{CN}$	0.13 (0.19)	0.75 (0.76)	1.52 (2.11)	0.29 (0.36)	n.d.	n.d.	n.d.	3.24 (3.35)	1.08 (1.22)
$(La/Y)_{CN}$	0.21 (0.25)	1.37 (1.22)	1.03 (0.95)	0.30 (0.25)	2.73 (2.55)	1.41 (1.54)	0.84 (0.81)	1.85 (1.40)	1.20 (1.27)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.90 (1.19)	0.84 (0.65)	0.99 (0.90)	1.18 (0.85)	0.65 (0.54)	0.75 (0.94)	1.63 (2.62)	0.93 (0.48)	1.59 (1.39)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _B_16	CMNMC82045 _B_17	CMNMC82045 _B_18	CMNMC82045 _B_19	CMNMC82045 _B_20	CMNMC82045 _B_21	CMNMC82045 _B_22	CMNMC82045_ B_23	CMNMC82045_ B_24
Li	3 (6.6)	≤ LOD	20 (13.0)	≤ LOD	7 (9.6)	9 (8.4)	12 (11.0)	≤ LOD	≤ LOD
B	33 (3.9)	34 (4.4)	31 (6.8)	38 (2.9)	38 (6.7)	38 (2.5)	32 (8.7)	37 (3.0)	39 (2.9)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	2 (29.0)	28 (27.0)	≤ LOD	8 (23.0)	5 (11.0)	10 (12.0)
V	2 (1.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (23.0)	≤ LOD	6 (24.0)	≤ LOD	≤ LOD
Mn	≤ LOD	11.0 (12.0)	18.0 (12.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	14 (33.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	0.9 (1.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.1 (1.0)	≤ LOD	≤ LOD	1.2 (1.0)
Ni	≤ LOD	≤ LOD	3 (9.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (8.2)
Cu	≤ LOD	2 (5.3)	5 (4.1)	5 (5.1)	2 (4.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	4 (5.5)	≤ LOD	≤ LOD	4 (5.0)	≤ LOD	4 (2.3)	≤ LOD
As	757 (95.0)	1130 (100.0)	1870 (580.0)	970 (110.0)	774 (97.0)	960 (110.0)	730 (160.0)	1019 (71.0)	1020 (120.0)
Rb	0.6 (0.7)	≤ LOD	≤ LOD	0.9 (0.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	110.8 (9.9)	134.0 (25.0)	107.0 (18.0)	158.0 (27.0)	443.0 (94.0)	553.0 (83.0)	630.0 (140.0)	667.0 (45.0)	696.0 (54.0)
Y	58.0 (15.0)	6.7 (1.9)	28.0 (14.0)	9.3 (7.6)	3.1 (0.8)	12.0 (2.7)	7.0 (1.8)	5.5 (0.9)	3.3 (0.6)
Mo	20700 (5000.0)	7600 (1400.0)	27000 (13000.0)	13800 (2500.0)	10600 (4300.0)	10200 (1200.0)	6800 (1600.0)	9800 (730.0)	7400 (810.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.1 (1.2)	0.5 (0.4)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	960000 (150000)	902000 (53000)	830000 (170000)	870000 (120000)	990000 (120000)	902000 (83000)	970000 (240000)	967000 (80000)	1004000 (98000)
La	19.9 (3.70)	0.4 (0.44)	3.7 (2.60)	≤ LOD	0.8 (0.32)	2.9 (0.83)	0.8 (0.28)	1.0 (0.23)	0.4 (0.14)
Ce	51.3 (9.60)	1.5 (1.40)	19.0 (13.00)	0.9 (0.56)	2.5 (0.71)	8.2 (1.20)	4.0 (0.82)	3.2 (0.55)	1.6 (0.45)
Pr	5.4 (1.30)	0.3 (0.16)	2.3 (1.50)	0.2 (0.20)	0.3 (0.09)	1.3 (0.29)	0.6 (0.29)	0.4 (0.09)	0.2 (0.12)
Nd	19.5 (6.20)	0.6 (0.52)	7.8 (4.80)	2.6 (2.30)	0.5 (0.44)	4.1 (1.40)	1.8 (1.30)	1.8 (0.69)	0.6 (0.39)
Sm	6.9 (3.40)	1.1 (0.68)	3.4 (1.70)	5.0 (4.20)	≤ LOD	0.9 (0.70)	≤ LOD	0.7 (0.32)	≤ LOD
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	5.9 (3.90)	2.0 (1.40)	6.4 (2.80)	6.4 (5.10)	≤ LOD	0.8 (0.53)	0.6 (0.45)	0.6 (0.28)	0.3 (0.30)
Tb	1.2 (0.57)	1.0 (0.36)	2.9 (1.30)	1.5 (1.20)	≤ LOD	0.3 (0.09)	0.2 (0.17)	0.3 (0.10)	0.2 (0.08)
Dy	8.6 (3.30)	7.2 (2.30)	17.9 (6.60)	12.0 (10.00)	0.8 (0.42)	4.1 (1.30)	2.7 (0.92)	2.5 (0.47)	2.3 (0.79)
Ho	2.3 (0.73)	1.5 (0.60)	4.2 (1.70)	2.0 (1.80)	0.4 (0.12)	1.4 (0.37)	0.8 (0.28)	0.8 (0.20)	0.7 (0.19)
Er	10.5 (3.00)	4.0 (2.00)	15.4 (6.80)	5.5 (5.10)	2.0 (0.83)	8.6 (2.10)	5.0 (1.30)	5.7 (0.88)	3.3 (0.72)
Tm	2.9 (0.86)	0.8 (0.28)	3.7 (2.00)	0.4 (0.36)	0.8 (0.18)	2.5 (0.19)	1.8 (0.47)	1.8 (0.19)	1.3 (0.24)
Yb	29.0 (6.10)	5.5 (1.00)	41.0 (24.00)	4.7 (2.50)	14.7 (3.60)	41.8 (7.40)	26.0 (7.50)	23.9 (3.10)	17.3 (2.30)
Lu	6.7 (1.30)	0.9 (0.36)	7.9 (4.70)	0.9 (0.39)	3.0 (0.58)	8.3 (1.30)	5.1 (1.20)	4.6 (0.43)	3.5 (0.52)
∑REE + Y	228.2 (15.3)	33.4 (4.1)	163.6 (30.2)	51.5 (13.7)	29.1 (4.2)	97.2 (8.3)	56.8 (8.0)	52.9 (3.6)	35.1 (2.9)
$(La/Lu)_{CN}$	0.31 (0.19)	0.05 (0.06)	0.05 (0.06)	0.02 (0.02)	0.03 (0.02)	0.04 (0.02)	0.02 (0.01)	0.02 (0.01)	0.01 (0.01)
$(La/Sm)_{CN}$	1.81 (1.49)	0.26 (0.33)	0.68 (0.75)	0.02 (0.02)	n.d.	1.98 (2.03)	1.49 (1.81)	0.88 (0.71)	3.40 (5.39)
$(La/Y)_{CN}$	2.28 (1.52)	0.44 (0.49)	0.88 (0.96)	0.10 (0.13)	1.70 (1.37)	1.61 (1.15)	0.79 (0.61)	1.23 (0.77)	0.76 (0.57)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	1.17 (0.41)	1.04 (1.48)	1.52 (1.80)	1.04 (1.76)	1.20 (0.69)	1.00 (0.39)	1.28 (0.91)	1.26 (0.48)	1.26 (0.96)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _B_25	CMNMC82045 _C_1	CMNMC82045 _C_2	CMNMC82045 _C_3	CMNMC82045 _C_4	CMNMC82045 _C_5	CMNMC82045 _C_6	CMNMC82045_ C_7	CMNMC82045_ C_8
Li	≤ LOD	3 (7.3)	≤ LOD	4 (5.3)	3 (5.7)	2 (5.7)	2 (4.7)	≤ LOD	1 (3.4)
B	24 (13.0)	23 (3.7)	24 (2.6)	24 (2.0)	26 (1.5)	25 (1.8)	22 (2.9)	23 (1.6)	22 (2.3)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	45 (57.0)	≤ LOD
Ti	≤ LOD	2 (19.0)	12 (14.0)	≤ LOD	9 (19.0)	≤ LOD	4 (11.0)	2 (10.0)	4 (12.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.6)	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	2.6 (8.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4.0 (8.4)	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (1.2)	≤ LOD	0.9 (0.8)	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	2 (3.6)	≤ LOD	3 (11.0)	2 (11.0)	≤ LOD	3 (6.6)
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	6 (6.2)	≤ LOD	2 (1.8)	2 (1.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1650 (270.0)	291 (65.0)	406 (55.0)	513 (59.0)	422 (48.0)	381 (46.0)	338 (39.0)	235 (17.0)	214 (23.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	526.0 (50.0)	251.0 (38.0)	188.0 (18.0)	181.0 (15.0)	171.0 (23.0)	152.0 (15.0)	97.0 (14.0)	98.2 (9.2)	87.7 (8.0)
Y	3.3 (0.7)	4.7 (1.1)	4.1 (0.9)	5.4 (1.5)	14.2 (2.8)	15.8 (3.3)	12.3 (2.1)	13.8 (1.8)	14.8 (2.4)
Mo	10400 (2000.0)	37500 (9000.0)	19200 (3400.0)	37000 (11000.0)	53000 (4400.0)	31500 (6800.0)	25900 (5100.0)	17200 (2300.0)	11100 (1200.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	803000 (92000)	870000 (110000)	881000 (77000)	850000 (110000)	850000 (69000)	980000 (140000)	835000 (98000)	874000 (62000)	814000 (80000)
La	0.9 (0.28)	0.8 (0.31)	0.7 (0.18)	1.0 (0.29)	2.5 (0.35)	1.6 (0.37)	1.6 (0.28)	1.1 (0.27)	1.0 (0.20)
Ce	1.9 (0.67)	3.0 (0.28)	1.7 (0.48)	2.8 (0.89)	8.5 (0.93)	7.6 (1.90)	6.6 (1.70)	4.9 (0.90)	4.0 (0.70)
Pr	0.3 (0.14)	0.7 (0.22)	0.3 (0.10)	0.6 (0.17)	1.4 (0.27)	1.8 (0.51)	1.4 (0.26)	1.1 (0.22)	0.9 (0.20)
Nd	1.2 (0.65)	1.8 (0.71)	0.9 (0.41)	2.1 (0.80)	5.3 (1.10)	6.1 (1.70)	4.6 (1.10)	4.1 (0.95)	2.9 (0.65)
Sm	0.6 (0.41)	≤ LOD	0.5 (0.35)	0.6 (0.37)	1.0 (0.55)	1.8 (0.82)	2.1 (0.69)	1.7 (0.68)	1.7 (0.43)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.5 (0.37)	0.7 (0.59)	≤ LOD	0.9 (0.34)	2.1 (0.83)	2.7 (1.00)	2.0 (0.83)	2.3 (0.68)	2.0 (0.63)
Tb	≤ LOD	0.2 (0.13)	≤ LOD	0.2 (0.07)	0.6 (0.19)	0.6 (0.27)	0.5 (0.15)	0.7 (0.15)	0.6 (0.17)
Dy	2.4 (0.71)	1.7 (0.93)	1.5 (0.48)	2.0 (0.80)	4.6 (1.00)	8.5 (2.30)	5.1 (1.20)	5.6 (1.10)	7.1 (1.40)
Ho	0.6 (0.11)	0.6 (0.23)	0.5 (0.14)	0.5 (0.17)	1.4 (0.20)	2.0 (0.37)	1.3 (0.23)	1.5 (0.23)	2.0 (0.25)
Er	2.9 (0.73)	2.5 (0.69)	2.9 (0.71)	2.9 (0.55)	6.6 (1.20)	10.2 (1.90)	7.8 (1.60)	8.6 (1.10)	8.0 (1.80)
Tm	1.4 (0.34)	0.9 (0.21)	0.9 (0.16)	1.1 (0.26)	2.6 (0.44)	3.2 (0.50)	2.5 (0.62)	2.7 (0.41)	2.8 (0.51)
Yb	21.3 (3.00)	10.9 (1.70)	12.5 (1.50)	12.9 (2.40)	29.6 (5.70)	38.8 (4.90)	29.1 (5.10)	31.2 (3.00)	36.1 (4.00)
Lu	2.9 (0.44)	2.0 (0.26)	2.4 (0.45)	2.6 (0.42)	4.9 (0.75)	7.7 (1.30)	5.6 (0.82)	5.2 (0.52)	5.7 (0.46)
∑REE + Y	40.2 (3.6)	30.8 (2.6)	29.0 (2.2)	35.4 (3.1)	85.2 (6.3)	108.3 (6.7)	82.6 (6.1)	84.5 (4.0)	89.6 (4.9)
$(La/Lu)_{CN}$	0.03 (0.02)	0.04 (0.03)	0.03 (0.02)	0.04 (0.03)	0.05 (0.03)	0.02 (0.01)	0.03 (0.02)	0.02 (0.01)	0.02 (0.01)
$(La/Sm)_{CN}$	0.98 (1.01)	1.60 (1.87)	0.81 (0.79)	1.06 (1.05)	1.62 (1.36)	0.55 (0.46)	0.47 (0.33)	0.43 (0.34)	0.39 (0.26)
$(La/Y)_{CN}$	1.77 (1.30)	1.19 (0.92)	1.08 (0.75)	1.17 (0.89)	1.17 (0.68)	0.65 (0.44)	0.86 (0.51)	0.55 (0.33)	0.47 (0.28)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.87 (0.56)	0.91 (0.48)	0.86 (0.44)	0.91 (0.49)	1.08 (0.31)	0.93 (0.47)	0.95 (0.36)	0.96 (0.36)	0.89 (0.33)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _C_9	CMNMC82045 _C_10	CMNMC82045 _C_11	CMNMC82045 _C_12	CMNMC82045 _C_13	CMNMC82045 _C_14	CMNMC82045 _C_15	CMNMC82045_ C_16	CMNMC82045_ C_17
Li	≤ LOD	6 (13.0)	8 (7.3)	≤ LOD	13 (9.2)	≤ LOD	≤ LOD	8 (11.0)	4 (9.0)
B	23 (2.2)	24 (2.7)	25 (2.2)	25 (2.2)	22 (2.9)	25 (1.0)	28 (2.2)	27 (1.7)	27 (1.9)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	29 (48.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	6 (29.0)	8 (14.0)	8 (23.0)	15 (14.0)	3 (6.6)	≤ LOD	≤ LOD	16 (20.0)
V	≤ LOD	≤ LOD	≤ LOD	2 (3.1)	≤ LOD	≤ LOD	2 (1.8)	≤ LOD	≤ LOD
Cr	≤ LOD	11 (24.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	2.8 (8.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	1.3 (0.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	2 (7.4)	4 (5.8)	≤ LOD	6 (6.3)	3 (7.3)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	6 (9.7)	≤ LOD	≤ LOD	4 (2.0)	≤ LOD	≤ LOD	≤ LOD	4 (3.9)
Zn	3 (5.4)	3 (4.4)	≤ LOD	2 (3.8)	≤ LOD	≤ LOD	5 (3.4)	3 (3.6)	≤ LOD
As	322 (43.0)	380 (59.0)	645 (56.0)	490 (43.0)	357 (56.0)	416 (40.0)	435 (35.0)	450 (92.0)	770 (130.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	91.0 (12.0)	114.9 (8.7)	163.0 (21.0)	155.2 (9.0)	112.0 (11.0)	116.0 (11.0)	112.0 (12.0)	113.0 (18.0)	124.0 (18.0)
Y	11.7 (2.2)	13.2 (2.3)	16.3 (1.9)	15.3 (1.0)	12.4 (2.1)	14.4 (1.4)	16.0 (3.7)	12.2 (1.7)	10.4 (1.9)
Mo	13900 (2000.0)	22000 (5500.0)	35600 (5200.0)	19400 (3000.0)	8500 (1200.0)	11700 (1700.0)	13900 (2000.0)	10600 (1500.0)	18900 (5900.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	1.0 (1.1)	≤ LOD	0.9 (0.8)	0.6 (0.7)	0.8 (1.1)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	840000 (100000)	880000 (170000)	880000 (130000)	862000 (92000)	827000 (79000)	888000 (75000)	990000 (120000)	889000 (84000)	978000 (93000)
La	0.7 (0.21)	1.1 (0.53)	2.2 (0.45)	1.7 (0.53)	1.0 (0.34)	1.2 (0.29)	1.0 (0.25)	1.0 (0.25)	0.9 (0.25)
Ce	3.2 (0.59)	6.4 (2.20)	8.6 (0.81)	5.6 (0.89)	4.4 (0.37)	3.8 (0.59)	5.2 (0.93)	3.9 (0.86)	3.7 (0.54)
Pr	0.7 (0.21)	1.3 (0.23)	1.3 (0.32)	1.1 (0.35)	0.7 (0.13)	0.8 (0.25)	0.7 (0.29)	0.6 (0.37)	0.5 (0.18)
Nd	3.9 (1.10)	6.6 (2.40)	4.6 (1.30)	4.1 (1.70)	2.3 (0.59)	2.0 (0.81)	3.6 (1.50)	1.9 (1.00)	1.3 (0.59)
Sm	1.0 (0.49)	3.1 (2.10)	2.0 (0.74)	2.2 (0.82)	0.8 (0.58)	0.7 (0.33)	1.2 (0.91)	1.2 (0.81)	0.6 (0.41)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.8 (0.38)	2.8 (1.60)	2.3 (0.62)	1.9 (0.85)	1.3 (0.54)	1.7 (0.73)	2.4 (0.96)	0.9 (0.64)	0.6 (0.60)
Tb	0.5 (0.14)	0.7 (0.22)	0.7 (0.14)	0.6 (0.25)	0.4 (0.13)	0.3 (0.15)	0.5 (0.19)	0.4 (0.20)	0.3 (0.06)
Dy	5.4 (1.40)	6.5 (1.60)	8.3 (1.60)	7.9 (1.50)	5.1 (1.40)	6.3 (1.70)	6.0 (2.20)	3.8 (1.20)	3.7 (1.60)
Ho	1.4 (0.24)	1.7 (0.39)	1.9 (0.24)	2.2 (0.61)	1.4 (0.28)	1.8 (0.27)	1.7 (0.50)	1.2 (0.25)	1.4 (0.26)
Er	7.6 (1.20)	9.0 (2.20)	8.9 (1.10)	10.5 (1.40)	9.1 (1.30)	9.7 (1.10)	10.3 (1.40)	7.6 (0.62)	5.3 (0.86)
Tm	2.2 (0.33)	2.9 (0.22)	3.1 (0.27)	4.0 (0.82)	2.7 (0.27)	2.7 (0.33)	3.8 (0.86)	2.1 (0.37)	2.4 (0.47)
Yb	27.8 (4.20)	31.7 (5.40)	41.9 (5.20)	45.6 (8.20)	35.2 (2.10)	39.7 (4.20)	43.7 (4.80)	28.9 (4.50)	26.1 (4.40)
Lu	5.2 (0.71)	5.6 (0.76)	7.1 (0.72)	9.0 (1.00)	6.8 (0.43)	7.1 (0.55)	7.3 (0.83)	5.1 (1.00)	5.4 (0.65)
∑REE + Y	72.1 (5.0)	92.5 (7.4)	109.0 (6.0)	111.6 (8.9)	83.6 (3.3)	92.2 (5.0)	103.3 (6.1)	70.9 (5.2)	62.6 (5.1)
$(La/Lu)_{CN}$	0.01 (0.01)	0.02 (0.02)	0.03 (0.02)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.01 (0.01)	0.02 (0.01)	0.02 (0.01)
$(La/Sm)_{CN}$	0.43 (0.38)	0.22 (0.24)	0.68 (0.52)	0.47 (0.39)	0.81 (0.84)	0.99 (0.83)	0.53 (0.54)	0.51 (0.49)	0.92 (0.90)
$(La/Y)_{CN}$	0.40 (0.28)	0.54 (0.44)	0.89 (0.51)	0.72 (0.45)	0.55 (0.39)	0.54 (0.32)	0.41 (0.29)	0.55 (0.34)	0.58 (0.39)
$Eu_A = Eu/Eu^*$	n.d.	0.05 (0.12)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.98 (0.49)	1.11 (0.55)	1.17 (0.41)	0.96 (0.48)	1.16 (0.40)	0.94 (0.45)	1.39 (0.82)	1.13 (0.88)	1.25 (0.61)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _C_18	CMNMC82045 _C_19	CMNMC82045 _C_20	CMNMC82045 _C_21	CMNMC82045 _C_22	CMNMC82045 _C_23	CMNMC82045 _C_24	CMNMC82045_ C_25	CMNMC82045_ C_26
Li	10 (13.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (12.0)	6 (6.7)
B	27 (3.6)	24 (2.6)	26 (2.3)	24 (1.4)	25 (1.6)	26 (2.5)	25 (2.9)	26 (3.9)	25 (1.9)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	3 (21.0)	2 (7.3)	7 (17.0)	≤ LOD	7 (16.0)	7 (20.0)	20 (24.0)	3 (25.0)	8 (13.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.0 (14.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3.3 (5.6)	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.9 (0.8)
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (6.7)	≤ LOD	≤ LOD	12 (14.0)	≤ LOD
Cu	3 (3.9)	≤ LOD	2 (3.2)	≤ LOD	≤ LOD	2 (2.3)	3 (3.8)	≤ LOD	3 (3.3)
Zn	5 (3.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	623 (91.0)	972 (90.0)	340 (58.0)	365 (51.0)	395 (51.0)	455 (60.0)	563 (76.0)	557 (66.0)	594 (36.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.2 (0.8)	≤ LOD	0.7 (0.9)	≤ LOD	≤ LOD
Sr	101.0 (10.0)	113.8 (9.0)	96.0 (14.0)	94.0 (9.6)	102.0 (29.0)	305.0 (22.0)	429.0 (52.0)	467.0 (77.0)	348.0 (34.0)
Y	11.9 (3.5)	8.1 (2.7)	15.8 (5.1)	26.9 (3.7)	20.7 (6.6)	45.8 (4.9)	41.3 (3.5)	37.0 (10.0)	42.8 (5.3)
Mo	11900 (2000.0)	23800 (3700.0)	8700 (1300.0)	5350 (610.0)	6240 (710.0)	4400 (440.0)	5330 (560.0)	4810 (760.0)	4400 (480.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.5 (1.1)	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	940000 (200000)	860000 (75000)	739000 (90000)	842000 (93000)	930000 (90000)	950000 (120000)	873000 (65000)	910000 (110000)	909000 (90000)
La	1.3 (0.21)	0.8 (0.23)	1.3 (0.36)	1.9 (0.36)	2.3 (0.98)	7.0 (0.91)	8.9 (0.81)	7.7 (1.20)	6.7 (1.10)
Ce	2.8 (0.52)	2.1 (0.38)	4.0 (1.00)	6.9 (1.00)	6.3 (1.90)	23.2 (3.50)	27.0 (1.90)	20.4 (3.70)	18.3 (3.20)
Pr	0.6 (0.14)	0.3 (0.12)	0.8 (0.25)	0.8 (0.36)	1.0 (0.34)	2.0 (0.36)	3.0 (0.44)	2.4 (0.51)	2.3 (0.38)
Nd	1.4 (0.97)	1.6 (0.65)	2.1 (1.10)	3.6 (1.30)	2.9 (0.99)	9.0 (2.30)	7.8 (1.10)	6.6 (3.40)	9.7 (2.50)
Sm	1.1 (0.60)	0.8 (0.40)	1.1 (0.93)	1.2 (0.85)	1.7 (0.86)	2.1 (1.10)	3.6 (1.30)	2.8 (1.30)	3.0 (1.00)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.7 (0.67)	0.5 (0.34)	1.7 (1.10)	2.3 (1.40)	1.3 (0.71)	3.4 (1.30)	3.8 (1.00)	3.0 (1.20)	5.6 (2.70)
Tb	0.7 (0.29)	0.3 (0.13)	0.5 (0.16)	0.6 (0.20)	0.5 (0.19)	1.1 (0.32)	1.0 (0.40)	1.1 (0.12)	1.1 (0.26)
Dy	3.6 (0.87)	2.7 (0.63)	5.1 (2.00)	4.2 (0.99)	4.6 (1.00)	9.4 (1.60)	9.0 (1.60)	7.8 (2.60)	11.5 (3.60)
Ho	1.2 (0.39)	0.8 (0.30)	1.1 (0.29)	1.6 (0.40)	0.9 (0.27)	2.8 (0.80)	2.4 (0.43)	1.9 (0.36)	2.4 (0.45)
Er	8.2 (2.90)	4.0 (0.95)	5.1 (1.20)	6.6 (1.10)	5.9 (1.80)	13.4 (1.80)	12.6 (2.40)	10.6 (2.50)	13.1 (2.10)
Tm	2.3 (0.49)	1.4 (0.26)	1.7 (0.34)	1.7 (0.38)	1.9 (0.58)	4.1 (1.10)	4.5 (0.53)	3.4 (0.68)	4.2 (0.96)
Yb	25.6 (4.50)	17.0 (2.70)	20.4 (4.10)	22.7 (3.40)	24.0 (6.60)	60.5 (7.90)	53.2 (8.70)	36.3 (4.70)	51.9 (6.80)
Lu	5.9 (1.50)	3.0 (0.60)	4.1 (0.85)	4.5 (0.87)	5.0 (1.40)	11.4 (1.80)	10.9 (1.50)	9.1 (1.60)	10.7 (1.20)
∑REE + Y	67.3 (5.9)	43.2 (3.3)	64.8 (5.3)	85.5 (4.6)	78.9 (7.6)	195.1 (9.7)	189.1 (9.8)	150.1 (8.3)	183.3 (9.7)
$(La/Lu)_{CN}$	0.02 (0.02)	0.03 (0.02)	0.03 (0.02)	0.04 (0.03)	0.05 (0.04)	0.06 (0.03)	0.08 (0.04)	0.09 (0.05)	0.06 (0.03)
$(La/Sm)_{CN}$	0.74 (0.61)	0.63 (0.57)	0.72 (0.76)	0.99 (0.95)	0.82 (0.79)	2.09 (1.69)	1.55 (1.04)	1.72 (1.36)	1.40 (0.99)
$(La/Y)_{CN}$	0.75 (0.50)	0.65 (0.51)	0.54 (0.42)	0.46 (0.27)	0.73 (0.63)	1.02 (0.49)	1.43 (0.60)	1.38 (0.90)	1.04 (0.56)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	0.03 (0.07)	n.d.	n.d.	0.03 (0.06)	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.74 (0.26)	1.06 (0.58)	0.90 (0.45)	1.38 (0.75)	1.03 (0.65)	1.48 (0.39)	1.25 (0.23)	1.13 (0.36)	1.11 (0.33)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _C_27	CMNMC82045 _C_28	CMNMC82045 _C_29	CMNMC82045 _C_30	CMNMC82045 _C_31	CMNMC82045 _C_32	CMNMC82045 _C_33	CMNMC82045_ C_34	CMNMC82045_ C_35
Li	10 (20.0)	12 (16.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	26 (1.9)	27 (3.4)	28 (4.6)	26 (2.2)	25 (2.8)	25 (2.8)	25 (2.3)	25 (1.8)	24 (2.6)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	31 (40.0)	≤ LOD	≤ LOD
Ti	≤ LOD	10 (16.0)	≤ LOD	22 (15.0)	≤ LOD	≤ LOD	≤ LOD	13 (28.0)	≤ LOD
V	≤ LOD	≤ LOD	2 (2.8)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5.0 (16.0)	5.6 (9.4)
Fe	19 (33.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	29 (43.0)	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	1.0 (1.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	8 (19.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (8.6)	≤ LOD
Cu	≤ LOD	≤ LOD	4 (3.4)	≤ LOD	≤ LOD	5 (7.8)	≤ LOD	≤ LOD	3 (4.9)
Zn	4 (4.8)	≤ LOD	4 (3.5)	≤ LOD	2 (3.4)	5 (5.2)	≤ LOD	5 (5.1)	7 (11.0)
As	570 (120.0)	690 (88.0)	500 (110.0)	540 (100.0)	429 (68.0)	335 (52.0)	515 (76.0)	795 (64.0)	516 (70.0)
Rb	1.1 (0.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (0.8)	1.1 (0.8)
Sr	245.0 (57.0)	215.0 (46.0)	204.0 (44.0)	240.0 (43.0)	245.0 (40.0)	302.0 (49.0)	297.0 (49.0)	324.0 (44.0)	314.0 (68.0)
Y	89.0 (33.0)	53.0 (21.0)	29.0 (12.0)	45.8 (5.3)	17.0 (12.0)	26.5 (9.3)	36.8 (4.4)	16.0 (4.6)	20.3 (3.9)
Mo	4180 (570.0)	8300 (2100.0)	6200 (1500.0)	5760 (700.0)	9300 (1900.0)	4480 (470.0)	4120 (500.0)	6810 (920.0)	4340 (810.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	1.6 (2.5)	1.1 (1.7)	0.7 (0.9)	1.1 (1.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	850000 (250000)	978000 (72000)	1020000 (180000)	1008000 (90000)	952000 (69000)	930000 (110000)	880000 (130000)	940000 (150000)	880000 (130000)
La	7.7 (1.20)	5.7 (2.90)	5.1 (2.30)	7.8 (1.40)	5.1 (1.90)	12.9 (3.10)	10.5 (2.50)	5.4 (1.70)	8.3 (1.60)
Ce	25.5 (9.40)	15.8 (7.90)	12.8 (7.00)	23.9 (1.30)	9.7 (5.50)	20.7 (8.10)	23.1 (6.20)	10.3 (2.10)	17.5 (3.60)
Pr	3.7 (1.90)	2.1 (1.00)	1.3 (0.61)	2.8 (0.41)	0.7 (0.61)	2.7 (0.67)	2.3 (0.54)	0.7 (0.22)	1.4 (0.33)
Nd	18.0 (13.00)	9.0 (5.70)	4.3 (3.30)	10.3 (3.10)	2.7 (2.10)	7.7 (4.90)	8.9 (3.20)	2.6 (1.80)	4.1 (1.00)
Sm	16.0 (11.00)	5.4 (3.70)	2.7 (1.40)	1.9 (1.50)	0.7 (0.66)	3.1 (1.10)	3.2 (1.60)	1.1 (0.57)	1.1 (1.00)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	16.8 (9.90)	8.1 (4.50)	3.1 (1.20)	4.9 (1.10)	0.9 (0.52)	1.9 (0.71)	2.2 (0.72)	1.2 (0.83)	1.2 (0.85)
Tb	3.6 (0.70)	1.3 (1.20)	0.9 (0.27)	0.9 (0.16)	0.2 (0.15)	0.6 (0.24)	0.6 (0.22)	0.4 (0.25)	0.3 (0.14)
Dy	29.4 (8.00)	16.0 (8.40)	5.2 (1.40)	8.0 (2.20)	2.9 (1.30)	6.4 (1.70)	5.9 (1.00)	1.8 (0.92)	4.0 (0.82)
Ho	7.1 (2.00)	3.2 (1.90)	2.1 (0.67)	2.2 (0.86)	0.6 (0.41)	1.7 (0.49)	1.7 (0.43)	0.7 (0.22)	1.1 (0.39)
Er	23.1 (5.30)	14.7 (5.70)	7.4 (2.60)	11.6 (1.90)	2.9 (1.50)	7.7 (3.20)	9.2 (2.30)	3.7 (0.67)	5.1 (1.70)
Tm	6.4 (2.30)	3.9 (1.50)	2.3 (0.79)	3.4 (0.88)	1.0 (0.42)	2.2 (0.63)	2.7 (0.35)	1.6 (0.62)	2.0 (0.42)
Yb	77.0 (11.00)	61.0 (19.00)	33.0 (10.00)	44.8 (6.80)	14.3 (5.80)	32.0 (11.00)	39.0 (10.00)	19.4 (2.90)	24.2 (9.10)
Lu	13.7 (1.80)	11.2 (3.50)	6.5 (2.30)	9.3 (1.70)	2.9 (0.91)	7.0 (2.50)	7.2 (0.91)	4.5 (0.94)	5.5 (0.97)
∑REE + Y	337.0 (26.6)	210.4 (25.0)	115.6 (13.6)	177.6 (8.8)	61.6 (8.9)	133.1 (15.6)	153.3 (12.9)	69.4 (4.9)	96.0 (10.3)
$(La/Lu)_{CN}$	0.06 (0.03)	0.05 (0.05)	0.08 (0.07)	0.09 (0.05)	0.18 (0.15)	0.19 (0.15)	0.15 (0.09)	0.13 (0.09)	0.16 (0.10)
$(La/Sm)_{CN}$	0.30 (0.28)	0.66 (0.72)	1.18 (1.17)	2.57 (2.53)	4.92 (5.79)	2.61 (2.01)	2.06 (1.77)	3.22 (2.99)	4.73 (4.96)
$(La/Y)_{CN}$	0.58 (0.42)	0.71 (0.68)	1.17 (1.09)	1.13 (0.62)	1.99 (2.07)	3.24 (2.49)	1.90 (1.13)	2.24 (1.74)	2.72 (1.69)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	1.14 (0.79)	1.09 (0.94)	1.16 (0.99)	1.23 (0.30)	1.11 (1.03)	0.81 (0.43)	1.08 (0.48)	1.10 (0.59)	1.14 (0.42)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _C_36	CMNMC82045 _C_37	CMNMC82045 _D_1	CMNMC82045 _D_2	CMNMC82045 _D_3	CMNMC82045 _D_4	CMNMC82045 _D_5	CMNMC82045_ D_6	CMNMC82045_ D_7
Li	≤ LOD	3 (5.7)	≤ LOD	≤ LOD	7 (9.2)	≤ LOD	3 (5.5)	≤ LOD	≤ LOD
B	24 (3.2)	19 (4.7)	≤ LOD	23 (1.2)	21 (3.3)	25 (1.9)	24 (1.2)	24 (2.3)	26 (2.5)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	7 (13.0)	≤ LOD	3 (27.0)	≤ LOD	7 (11.0)	16 (16.0)
V	2 (2.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.8)	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (16.0)
Mn	1.8 (6.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6.8 (8.9)	≤ LOD	1.0 (7.0)	1.5 (7.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	0.8 (0.9)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	6 (6.2)	≤ LOD	≤ LOD	11 (11.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	4 (4.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	2 (2.4)	≤ LOD	2 (1.3)	≤ LOD	≤ LOD	2 (1.9)	≤ LOD
As	682 (58.0)	1220 (140.0)	664 (89.0)	590 (48.0)	650 (110.0)	1480 (370.0)	1720 (270.0)	633 (72.0)	1210 (150.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.7)	≤ LOD	0.7 (0.5)	≤ LOD
Sr	258.0 (67.0)	147.0 (21.0)	330.0 (49.0)	236.0 (15.0)	264.0 (35.0)	286.0 (47.0)	250.0 (28.0)	294.0 (33.0)	443.0 (67.0)
Y	20.8 (4.4)	11.3 (2.9)	28.0 (4.6)	16.3 (8.6)	8.0 (1.3)	9.5 (7.4)	54.0 (14.0)	12.8 (2.3)	19.9 (3.6)
Mo	5080 (590.0)	5080 (740.0)	46200 (6900.0)	48000 (5900.0)	45700 (6100.0)	57500 (8000.0)	67900 (8600.0)	43400 (7000.0)	36600 (5000.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	850000 (80000)	900000 (170000)	885000 (54000)	720000 (92000)	740000 (120000)	880000 (120000)	759000 (49000)	797000 (79000)	796000 (73000)
La	5.3 (1.30)	1.7 (0.61)	4.4 (1.00)	0.9 (0.15)	0.6 (0.26)	1.6 (1.40)	6.1 (0.85)	2.7 (0.62)	5.0 (1.20)
Ce	13.3 (2.90)	4.8 (1.00)	15.7 (2.90)	3.5 (1.30)	2.3 (0.83)	4.9 (4.40)	26.1 (2.90)	8.0 (2.10)	15.9 (2.70)
Pr	1.1 (0.33)	0.8 (0.30)	2.8 (0.59)	0.6 (0.22)	0.5 (0.19)	1.2 (1.30)	5.7 (1.20)	1.7 (0.43)	2.5 (0.55)
Nd	2.5 (0.71)	2.4 (1.60)	9.2 (1.90)	4.3 (1.50)	2.7 (1.10)	4.7 (3.40)	26.9 (5.90)	6.9 (1.40)	9.8 (1.70)
Sm	1.0 (0.34)	2.1 (1.50)	4.6 (1.70)	1.3 (0.76)	1.4 (0.96)	2.5 (2.80)	18.1 (5.90)	2.7 (0.64)	2.5 (1.00)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	1.7 (0.87)	1.2 (0.69)	2.6 (0.83)	2.7 (1.90)	0.9 (0.09)	2.4 (1.60)	12.0 (4.10)	2.2 (0.67)	2.8 (1.10)
Tb	0.4 (0.19)	0.4 (0.22)	0.9 (0.19)	0.5 (0.17)	0.4 (0.18)	0.5 (0.35)	2.7 (0.83)	0.6 (0.23)	0.9 (0.27)
Dy	3.0 (0.79)	4.1 (2.60)	9.8 (2.20)	5.0 (1.90)	1.7 (0.77)	2.0 (2.00)	23.0 (5.90)	5.7 (1.30)	10.4 (2.50)
Ho	1.0 (0.41)	0.9 (0.47)	2.3 (0.46)	1.3 (0.50)	0.6 (0.12)	0.3 (0.16)	5.2 (0.82)	1.5 (0.31)	2.4 (0.56)
Er	4.6 (0.81)	3.3 (1.40)	12.6 (2.20)	7.6 (2.10)	4.4 (2.10)	2.5 (1.80)	22.1 (4.00)	8.3 (1.60)	12.6 (2.80)
Tm	1.3 (0.34)	0.8 (0.38)	3.9 (0.77)	2.3 (0.47)	1.2 (0.36)	1.1 (0.72)	7.3 (1.10)	2.7 (0.36)	4.2 (0.95)
Yb	17.7 (3.80)	10.2 (2.10)	47.0 (6.60)	30.2 (7.60)	17.5 (3.60)	12.4 (7.10)	89.0 (8.00)	33.5 (3.50)	56.0 (13.00)
Lu	4.8 (0.67)	2.3 (0.56)	8.7 (1.10)	4.9 (0.80)	3.2 (0.34)	2.8 (1.40)	14.0 (1.40)	6.2 (1.20)	9.5 (1.80)
∑REE + Y	78.5 (5.4)	46.2 (4.6)	152.4 (8.6)	81.3 (8.7)	45.4 (4.7)	48.5 (10.3)	312.1 (14.7)	95.4 (5.2)	154.4 (14.2)
$(La/Lu)_{CN}$	0.11 (0.07)	0.08 (0.06)	0.05 (0.03)	0.02 (0.01)	0.02 (0.01)	0.06 (0.07)	0.04 (0.02)	0.04 (0.03)	0.05 (0.04)
$(La/Sm)_{CN}$	3.19 (2.42)	0.52 (0.53)	0.60 (0.46)	0.42 (0.36)	0.29 (0.30)	0.40 (0.57)	0.21 (0.14)	0.63 (0.43)	1.25 (1.00)
$(La/Y)_{CN}$	1.69 (1.14)	1.02 (0.79)	1.04 (0.65)	0.35 (0.30)	0.53 (0.40)	1.12 (1.44)	0.75 (0.47)	1.40 (0.89)	1.67 (1.08)
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.26 (0.55)	0.97 (0.54)	1.05 (0.39)	1.11 (0.68)	0.98 (0.69)	0.80 (1.44)	0.96 (0.32)	0.86 (0.38)	1.07 (0.40)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _D_8	CMNMC82045 _D_9	CMNMC82045 _D_10	CMNMC82045 _D_11	CMNMC82045 _D_12	CMNMC82045 _D_13	CMNMC82045 _D_14	CMNMC82045_ D_15	CMNMC82045_ D_16
Li	8 (7.9)	≤ LOD	≤ LOD	≤ LOD	2 (3.9)	≤ LOD	8 (9.0)	≤ LOD	6 (5.5)
B	25 (1.6)	24 (2.4)	24 (2.8)	25 (1.3)	27 (2.7)	26 (2.3)	28 (2.4)	25 (1.5)	26 (1.4)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	3 (23.0)	3 (16.0)	≤ LOD	6 (13.0)	6 (11.0)	12 (17.0)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1.1)
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.8 (5.2)	2.5 (4.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2.5 (4.8)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	3 (7.1)	8 (10.0)	≤ LOD	≤ LOD	≤ LOD	2 (8.1)	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (2.2)	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	589 (44.0)	490 (110.0)	364 (43.0)	768 (76.0)	482 (83.0)	385 (68.0)	383 (78.0)	602 (40.0)	476 (31.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	240.0 (14.0)	228.0 (24.0)	190.0 (16.0)	131.0 (11.0)	176.0 (21.0)	173.0 (16.0)	249.0 (24.0)	260.0 (39.0)	136.0 (12.0)
Y	6.4 (1.8)	10.1 (3.2)	8.7 (2.0)	13.2 (1.1)	17.1 (2.9)	24.9 (4.1)	27.1 (4.3)	20.8 (3.2)	9.4 (0.7)
Mo	24500 (4400.0)	45100 (7100.0)	45300 (5400.0)	31200 (3600.0)	24200 (4200.0)	13900 (1600.0)	16300 (3100.0)	26900 (3600.0)	11060 (940.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	0.8 (0.9)	0.7 (0.6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	867000 (44000)	772000 (95000)	822000 (87000)	838000 (60000)	896000 (83000)	856000 (61000)	870000 (100000)	832000 (41000)	856000 (52000)
La	0.9 (0.23)	2.2 (0.74)	1.5 (0.37)	1.9 (0.32)	3.0 (0.67)	3.4 (1.20)	2.5 (0.48)	3.9 (0.89)	0.8 (0.18)
Ce	3.0 (0.92)	6.1 (2.00)	6.2 (0.98)	6.3 (0.65)	10.7 (1.80)	11.8 (2.50)	10.9 (2.40)	13.7 (2.90)	2.8 (0.33)
Pr	0.6 (0.20)	1.2 (0.40)	1.1 (0.18)	1.2 (0.28)	1.9 (0.32)	2.0 (0.42)	2.1 (0.51)	2.0 (0.50)	0.5 (0.13)
Nd	2.3 (0.80)	5.6 (2.20)	4.9 (1.30)	5.3 (1.10)	7.1 (1.80)	6.1 (1.50)	6.2 (1.40)	7.6 (2.00)	1.4 (0.41)
Sm	0.9 (0.44)	1.4 (0.56)	1.7 (0.77)	1.4 (0.46)	3.5 (1.10)	3.0 (0.97)	3.2 (0.88)	3.2 (0.95)	0.6 (0.30)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	0.4 (0.35)	1.4 (0.53)	0.9 (0.50)	1.6 (0.59)	3.1 (0.94)	3.1 (1.10)	2.9 (1.10)	2.7 (0.73)	0.9 (0.28)
Tb	0.3 (0.13)	0.3 (0.14)	0.3 (0.13)	0.4 (0.14)	1.0 (0.31)	1.0 (0.25)	1.0 (0.22)	0.9 (0.20)	0.3 (0.07)
Dy	2.5 (0.89)	4.8 (1.60)	3.7 (0.90)	5.5 (0.77)	9.2 (1.60)	7.8 (1.00)	11.3 (2.90)	9.0 (1.60)	2.9 (0.63)
Ho	0.7 (0.28)	1.4 (0.36)	0.8 (0.18)	1.4 (0.21)	2.2 (0.52)	2.5 (0.40)	2.7 (0.43)	2.5 (0.40)	1.1 (0.16)
Er	4.8 (1.50)	4.8 (1.80)	3.6 (0.92)	7.1 (1.20)	11.8 (2.10)	12.8 (2.20)	14.5 (2.30)	11.9 (1.50)	5.6 (0.68)
Tm	1.7 (0.54)	1.6 (0.57)	1.4 (0.31)	2.0 (0.30)	3.7 (0.70)	3.8 (0.58)	5.1 (0.86)	3.9 (0.57)	1.9 (0.21)
Yb	21.0 (6.10)	22.0 (6.80)	16.8 (3.80)	23.3 (1.80)	42.5 (8.90)	41.1 (6.40)	62.0 (11.00)	48.3 (6.00)	24.3 (2.70)
Lu	3.8 (1.00)	3.7 (0.98)	2.7 (0.59)	5.0 (0.83)	6.7 (1.20)	8.2 (1.40)	10.6 (1.70)	8.5 (0.96)	4.4 (0.54)
∑REE + Y	49.2 (6.7)	66.6 (8.0)	54.0 (4.6)	75.7 (3.1)	123.5 (9.9)	131.3 (7.9)	162.2 (12.2)	138.9 (7.6)	56.9 (3.2)
$(La/Lu)_{CN}$	0.02 (0.02)	0.06 (0.05)	0.06 (0.04)	0.04 (0.02)	0.05 (0.03)	0.04 (0.03)	0.02 (0.01)	0.05 (0.03)	0.02 (0.01)
$(La/Sm)_{CN}$	0.63 (0.56)	1.01 (0.87)	0.55 (0.47)	0.84 (0.59)	0.53 (0.39)	0.72 (0.59)	0.50 (0.34)	0.77 (0.56)	0.92 (0.80)
$(La/Y)_{CN}$	0.90 (0.67)	1.45 (1.17)	1.12 (0.78)	0.98 (0.49)	1.16 (0.73)	0.91 (0.65)	0.62 (0.37)	1.25 (0.77)	0.58 (0.31)
$Eu_A = Eu/Eu^*$	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
$Ce_A = Ce/Ce^*$	0.93 (0.52)	0.90 (0.53)	1.12 (0.36)	0.94 (0.31)	1.05 (0.34)	1.08 (0.47)	1.04 (0.43)	1.18 (0.49)	0.99 (0.37)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _D_17	CMNMC82045 _D_18	CMNMC82045 _D_19	CMNMC82045 _D_20	CMNMC82045 _D_21	CMNMC82045 _D_22	CMNMC82045 _D_23	CMNMC82045_ D_24	CMNMC82045_ D_25
Li	≤ LOD	17 (23.0)	11 (15.0)	≤ LOD	≤ LOD	≤ LOD	4 (6.0)	≤ LOD	3 (6.5)
B	27 (1.5)	27 (3.1)	29 (2.7)	25 (1.4)	27 (1.0)	28 (1.9)	26 (2.6)	26 (1.2)	26 (1.9)
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	100 (130.0)
Ti	9 (9.2)	≤ LOD	12 (20.0)	≤ LOD	≤ LOD	3 (8.0)	≤ LOD	≤ LOD	14 (18.0)
V	2 (2.3)	3 (2.8)	≤ LOD	≤ LOD	≤ LOD	2 (1.4)	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	6 (11.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	7.2 (6.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	10 (7.7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (3.4)
As	623 (45.0)	1280 (360.0)	770 (130.0)	1370 (150.0)	368 (28.0)	542 (46.0)	536 (48.0)	659 (38.0)	461 (54.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	334.0 (94.0)	171.0 (28.0)	171.0 (35.0)	207.0 (43.0)	369.0 (39.0)	170.0 (17.0)	367.0 (33.0)	408.0 (20.0)	184.0 (17.0)
Y	16.1 (3.5)	5.4 (0.5)	6.7 (1.3)	6.2 (1.8)	22.2 (2.5)	17.6 (2.8)	41.4 (4.2)	39.8 (7.2)	48.0 (10.0)
Mo	12700 (1500.0)	21300 (7400.0)	12600 (2600.0)	28300 (3600.0)	10000 (1500.0)	6220 (650.0)	4580 (420.0)	5220 (420.0)	4980 (500.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	832000 (61000)	910000 (150000)	830000 (160000)	834000 (40000)	885000 (42000)	918000 (58000)	860000 (70000)	898000 (44000)	831000 (76000)
La	4.0 (1.30)	1.1 (0.37)	1.3 (0.47)	1.1 (0.37)	7.9 (1.00)	2.7 (0.51)	8.2 (1.00)	7.0 (1.30)	6.5 (1.00)
Ce	11.4 (3.70)	2.0 (0.84)	2.3 (0.58)	3.8 (1.60)	16.9 (1.90)	7.7 (1.40)	21.9 (2.50)	17.8 (3.20)	21.3 (3.90)
Pr	1.6 (0.55)	0.2 (0.13)	0.3 (0.10)	0.3 (0.13)	1.9 (0.30)	1.0 (0.24)	2.8 (0.33)	2.4 (0.52)	2.7 (0.38)
Nd	4.1 (1.40)	≤ LOD	0.7 (0.51)	1.2 (0.48)	5.5 (1.10)	3.0 (0.73)	8.4 (1.70)	8.7 (2.20)	9.4 (2.50)
Sm	0.9 (0.62)	≤ LOD	≤ LOD	0.5 (0.26)	1.9 (0.49)	1.5 (0.48)	3.0 (0.95)	3.1 (0.82)	3.0 (1.30)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	1.0 (0.70)	0.8 (0.79)	0.3 (0.34)	0.3 (0.22)	1.9 (0.46)	1.6 (0.54)	3.3 (0.96)	2.2 (0.76)	4.0 (1.00)
Tb	0.5 (0.18)	≤ LOD	≤ LOD	≤ LOD	0.5 (0.10)	0.5 (0.10)	1.0 (0.19)	0.8 (0.18)	0.9 (0.23)
Dy	5.4 (1.80)	1.3 (0.84)	2.2 (0.75)	1.7 (0.57)	5.7 (1.10)	4.9 (0.86)	9.5 (1.60)	7.9 (1.60)	8.9 (1.40)
Ho	1.9 (0.58)	0.5 (0.27)	0.6 (0.24)	0.6 (0.23)	1.7 (0.19)	1.1 (0.24)	2.4 (0.32)	2.2 (0.40)	2.3 (0.46)
Er	8.4 (1.90)	2.7 (0.89)	3.4 (1.10)	3.4 (0.68)	8.8 (0.90)	5.5 (0.98)	11.7 (1.20)	11.4 (2.00)	11.6 (1.80)
Tm	3.0 (0.83)	1.0 (0.32)	1.2 (0.44)	1.2 (0.33)	2.9 (0.31)	1.8 (0.33)	4.0 (0.46)	3.4 (0.57)	3.8 (0.57)
Yb	38.3 (9.20)	15.5 (3.80)	19.6 (2.50)	15.4 (3.70)	40.2 (3.50)	21.4 (2.90)	49.4 (4.80)	47.5 (6.70)	48.7 (7.20)
Lu	6.7 (1.50)	3.0 (0.96)	3.3 (0.76)	3.1 (0.74)	7.3 (0.69)	4.6 (0.71)	10.5 (1.10)	9.6 (1.50)	9.8 (1.20)
∑REE + Y	103.3 (10.7)	33.7 (4.6)	42.1 (3.3)	38.9 (4.4)	125.3 (4.7)	74.9 (3.9)	177.4 (6.5)	163.7 (8.6)	180.9 (9.2)
$(La/Lu)_{CN}$	0.06 (0.05)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.11 (0.05)	0.06 (0.04)	0.08 (0.04)	0.08 (0.04)	0.07 (0.04)
$(La/Sm)_{CN}$	2.95 (3.03)	2.74 (4.21)	5.22 (8.05)	1.52 (1.42)	2.66 (1.66)	1.17 (0.84)	1.72 (1.14)	1.42 (0.95)	1.36 (1.04)
$(La/Y)_{CN}$	1.65 (1.22)	1.30 (0.88)	1.24 (0.94)	1.22 (0.96)	2.37 (1.16)	1.02 (0.60)	1.32 (0.62)	1.17 (0.71)	0.90 (0.54)
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.09 (0.63)	0.98 (0.77)	0.87 (0.51)	1.45 (0.95)	1.03 (0.24)	1.10 (0.39)	1.10 (0.23)	1.05 (0.36)	1.21 (0.34)

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TABLE C29. *(continued)*

Sample (ppm)	CMNMC82045 _D_26	CMNMC82045 _D_27	CMNMC82045 _D_28	CMNMC82045_ D_29
Li	18 (25.0)	≤ LOD	5 (5.4)	≤ LOD
B	26 (5.4)	26 (1.5)	24 (2.5)	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	40 (670.0)
Ti	16 (45.0)	≤ LOD	≤ LOD	9 (27.0)
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	4 (32.0)
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	2 (6.3)
Zn	4 (3.8)	≤ LOD	≤ LOD	≤ LOD
As	286 (56.0)	609 (48.0)	620 (48.0)	720 (120.0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	193.0 (55.0)	362.0 (34.0)	385.0 (23.0)	389.0 (56.0)
Y	38.0 (15.0)	30.2 (5.4)	38.3 (3.7)	27.9 (5.4)
Mo	4900 (1000.0)	5950 (450.0)	4550 (230.0)	5030 (710.0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	0.6 (0.4)	18.0 (16.0)
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	830000 (150000)	909000 (51000)	848000 (69000)	533000 (73000)
La	7.2 (2.50)	7.6 (1.30)	8.6 (0.86)	5.7 (1.60)
Ce	16.5 (5.80)	17.8 (3.30)	21.0 (2.00)	15.6 (2.60)
Pr	2.0 (0.76)	2.0 (0.40)	2.5 (0.30)	1.8 (0.62)
Nd	7.9 (3.40)	6.2 (1.50)	9.1 (1.20)	3.9 (1.10)
Sm	1.0 (0.96)	2.4 (0.62)	2.7 (0.71)	3.3 (1.80)
Eu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Gd	1.8 (1.20)	2.5 (0.60)	3.0 (0.73)	2.0 (1.40)
Tb	0.5 (0.18)	0.5 (0.09)	0.8 (0.13)	0.4 (0.22)
Dy	5.2 (2.60)	6.7 (1.30)	8.0 (0.94)	4.3 (1.00)
Ho	1.9 (0.99)	1.8 (0.33)	2.0 (0.26)	1.4 (0.51)
Er	8.1 (3.90)	8.9 (1.50)	10.5 (1.10)	7.2 (1.60)
Tm	2.3 (1.20)	2.8 (0.45)	3.4 (0.31)	2.4 (0.79)
Yb	34.0 (15.00)	39.6 (5.90)	46.7 (4.40)	26.5 (1.90)
Lu	7.2 (2.70)	7.5 (1.10)	9.8 (1.10)	5.4 (0.96)
∑REE + Y	133.5 (17.7)	136.4 (7.6)	166.4 (5.6)	107.6 (5.1)
$(La/Lu)_{CN}$	0.10 (0.09)	0.10 (0.06)	0.09 (0.04)	0.11 (0.07)
$(La/Sm)_{CN}$	4.70 (5.46)	2.01 (1.32)	2.00 (1.21)	1.08 (0.98)
$(La/Y)_{CN}$	1.26 (1.08)	1.67 (0.99)	1.49 (0.66)	1.36 (0.94)
Eu_A = Eu/Eu*	n.d.	n.d.	n.d.	n.d.
Ce_A = Ce/Ce*	1.02 (0.63)	1.09 (0.35)	1.08 (0.20)	1.17 (0.56)

TABLE C30. The Ovens, NS, Canada (M6-5B).

Sample (ppm)	OV-05-01B_1	OV-05-01B_2	OV-05-01B_2	OV-05-01B_2	OV-05-01B_3	OV-05-01B_3	OV-05-01B_4	OV-05-01B_5	OV-05-01B_6
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	5.8 (0.7)	6.0 (1.2)	6.4 (1.1)	9.4 (1.4)	9.1 (1.3)	8.2 (2.2)	6.8 (0.6)	7.4 (0.6)	7.5 (1.6)
Sr	534.2 (41.2)	734.4 (102.1)	784.8 (73.5)	929.8 (100.9)	984.1 (72.8)	881.5 (151.1)	860.8 (38.5)	843.8 (46.0)	891.8 (104.2)
Y	341.3 (17.9)	136.9 (23.2)	94.8 (24.6)	193.5 (10.4)	220.1 (19.1)	104.1 (11.7)	264.1 (11.4)	156.8 (7.2)	409.2 (283.7)
Nb	2 (0.3)	≤ LOD	≤ LOD	1 (0.4)	2 (0.5)	1 (0.3)	2 (0.4)	2 (0.2)	1 (0.3)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Pb	14 (1)	18 (2)	20 (3)	20 (2)	28 (2)	23 (3)	19 (1)	18 (2)	21 (3)
La	47.8 (3.05)	20.0 (2.19)	18.6 (3.42)	26.4 (1.41)	26.9 (2.38)	16.0 (1.07)	27.3 (1.42)	19.5 (0.69)	22.9 (12.49)
Ce	112.8 (7.21)	40.0 (4.92)	32.2 (5.60)	55.5 (3.14)	65.3 (6.05)	31.9 (2.85)	74.0 (3.17)	43.8 (2.22)	44.5 (17.09)
Pr	18.3 (0.88)	6.0 (0.71)	4.7 (0.65)	10.2 (1.12)	11.5 (1.02)	5.0 (0.53)	13.0 (0.58)	8.5 (0.42)	6.9 (2.19)
Nd	89.8 (4.60)	29.3 (4.80)	20.0 (4.66)	52.1 (2.68)	58.2 (7.14)	23.5 (3.15)	74.2 (4.53)	49.9 (2.34)	39.2 (11.64)
Sm	46.2 (2.17)	18.4 (2.91)	11.0 (3.78)	31.0 (2.50)	37.4 (3.00)	11.6 (2.26)	46.0 (2.79)	33.4 (1.78)	29.9 (10.11)
Eu	120.44 (8.56)	75.47 (1.03)	97.88 (16.92)	80.68 (4.46)	74.98 (6.48)	56.70 (9.96)	92.27 (5.56)	69.28 (3.88)	66.89 (10.63)
Gd	77.0 (4.69)	26.5 (5.05)	15.9 (6.22)	47.6 (4.11)	61.8 (4.57)	17.7 (4.29)	72.2 (5.59)	57.8 (2.86)	51.5 (19.72)
Tb	12.2 (0.80)	4.2 (0.78)	2.5 (0.99)	7.0 (0.61)	9.1 (1.19)	2.9 (0.54)	10.7 (0.83)	8.3 (0.46)	7.8 (4.81)
Dy	65.3 (4.27)	21.6 (3.24)	15.7 (5.80)	37.8 (3.20)	52.6 (4.92)	17.6 (3.28)	57.0 (4.53)	41.6 (2.62)	47.3 (36.06)
Ho	10.8 (0.63)	3.2 (0.53)	2.5 (1.07)	6.3 (0.30)	8.5 (0.71)	2.7 (0.45)	9.3 (0.66)	6.4 (0.34)	7.4 (5.38)
Er	30.2 (2.46)	9.8 (2.26)	7.2 (2.17)	16.6 (0.85)	22.8 (2.05)	7.7 (1.36)	23.6 (1.30)	15.7 (1.11)	21.7 (17.69)
Tm	3.9 (0.25)	1.5 (0.29)	1.4 (0.47)	2.4 (0.17)	2.7 (0.32)	0.9 (0.12)	2.8 (0.19)	2.0 (0.15)	3.4 (2.94)
Yb	23.3 (1.77)	9.8 (1.34)	9.6 (1.95)	14.0 (1.61)	15.6 (1.38)	6.7 (0.72)	16.9 (1.24)	11.2 (0.70)	27.1 (32.17)
Lu	2.9 (0.22)	1.1 (0.15)	1.0 (0.15)	1.6 (0.20)	1.7 (0.10)	0.8 (0.05)	1.7 (0.09)	1.3 (0.07)	3.0 (3.03)
∑REE + Y	1002.1 (14.6)	403.8 (10.3)	334.8 (21.2)	582.6 (8.8)	669.2 (14.1)	305.9 (12.5)	785.4 (11.3)	525.4 (6.8)	788.6 (62.5)
$(La/Lu)_{CN}$	1.71 (0.64)	1.81 (0.88)	1.88 (1.08)	1.71 (0.72)	1.60 (0.61)	2.00 (0.72)	1.63 (0.52)	1.51 (0.46)	0.80 (1.00)
$(La/Sm)_{CN}$	0.65 (0.22)	0.68 (0.35)	1.06 (0.77)	0.53 (0.20)	0.45 (0.19)	0.86 (0.44)	0.37 (0.12)	0.37 (0.11)	0.48 (0.45)
$(La/Y)_{CN}$	0.93 (0.32)	0.97 (0.51)	1.30 (0.87)	0.91 (0.30)	0.81 (0.34)	1.02 (0.43)	0.69 (0.21)	0.83 (0.23)	0.37 (0.41)
$Eu_A = Eu/Eu^*$	6.09 (0.67)	10.37 (2.61)	22.52 (12.45)	6.36 (0.85)	4.71 (0.67)	11.97 (4.33)	4.84 (0.58)	4.75 (0.45)	5.13 (2.81)
$Ce_A = Ce/Ce^*$	0.91 (0.10)	0.87 (0.18)	0.81 (0.25)	0.81 (0.11)	0.89 (0.14)	0.85 (0.13)	0.93 (0.08)	0.82 (0.07)	0.84 (0.65)

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TABLE C30. *(continued)*

Sample (ppm)	OV-05-01B_6	OV-05-01B_7	OV-05-01B_8	OV-05-01B_9	OV-05-01B_10	OV-05-01B_10	OV-05-01B_11	OV-05-01B_12	OV-05-01B_13
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	7.6 (0.7)	6.8 (0.6)	6.6 (0.8)	7.8 (0.7)	7.4 (0.9)	9.2 (1.5)	13.9 (4.1)	5.9 (0.4)	8.5 (0.6)
Sr	1004.7 (82.1)	745.4 (52.5)	827.1 (49.3)	773.0 (41.3)	949.8 (107.9)	913.2 (117.4)	820.6 (32.0)	599.3 (32.9)	949.1 (42.4)
Y	146.8 (6.3)	14.3 (0.6)	219.4 (16.8)	106.7 (5.3)	82.5 (6.7)	213.2 (9.8)	58.1 (3.6)	106.8 (4.5)	65.2 (5.2)
Nb	1 (0.3)	≤ LOD	1 (0.2)	≤ LOD	1 (0.5)	2 (0.6)	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Pb	20 (2)	16 (1)	17 (1)	17 (1)	22 (2)	25 (4)	25 (4)	14 (1)	22 (1)
La	23.1 (2.13)	6.8 (0.35)	29.8 (1.54)	21.7 (0.96)	17.5 (1.56)	28.4 (1.05)	13.9 (0.51)	23.1 (0.70)	14.7 (0.64)
Ce	46.8 (4.62)	4.4 (0.22)	62.1 (3.68)	33.5 (1.78)	26.4 (1.63)	60.6 (3.59)	17.8 (0.87)	31.6 (1.29)	21.8 (1.10)
Pr	7.2 (0.63)	0.3 (0.04)	9.6 (0.67)	4.2 (0.29)	3.4 (0.20)	9.6 (0.77)	2.2 (0.11)	4.0 (0.17)	2.8 (0.21)
Nd	35.3 (1.42)	0.8 (0.12)	41.3 (2.43)	15.8 (1.18)	15.2 (1.30)	47.8 (3.44)	9.0 (0.42)	15.6 (0.59)	11.3 (1.17)
Sm	18.1 (1.63)	≤ LOD	20.2 (1.37)	7.3 (0.53)	7.7 (0.57)	26.4 (2.99)	4.6 (0.23)	6.8 (0.22)	5.9 (0.87)
Eu	73.69 (4.69)	32.11 (2.27)	86.64 (3.54)	57.88 (3.90)	51.80 (2.39)	66.54 (6.00)	58.09 (2.27)	86.83 (3.60)	49.77 (2.73)
Gd	33.0 (2.81)	0.5 (0.10)	28.9 (1.94)	10.6 (0.86)	12.2 (1.36)	44.1 (4.69)	7.5 (0.56)	9.8 (0.49)	8.4 (1.37)
Tb	5.4 (0.41)	≤ LOD	4.8 (0.35)	1.8 (0.12)	2.2 (0.20)	7.6 (0.70)	1.2 (0.08)	1.7 (0.11)	1.6 (0.27)
Dy	27.8 (2.19)	0.5 (0.09)	29.7 (2.33)	12.5 (0.77)	12.4 (1.54)	41.4 (4.46)	6.3 (0.45)	10.4 (0.67)	8.8 (1.45)
Ho	4.4 (0.29)	≤ LOD	5.1 (0.36)	2.3 (0.17)	2.2 (0.22)	7.1 (0.81)	1.1 (0.09)	1.9 (0.13)	1.6 (0.25)
Er	12.3 (0.76)	0.5 (0.06)	15.3 (1.35)	7.4 (0.43)	6.1 (0.70)	18.3 (1.54)	3.3 (0.24)	6.2 (0.43)	4.6 (0.53)
Tm	1.7 (0.10)	≤ LOD	2.6 (0.23)	1.3 (0.10)	0.9 (0.07)	2.4 (0.25)	0.6 (0.07)	1.2 (0.07)	0.7 (0.08)
Yb	11.4 (0.53)	2.0 (0.19)	17.3 (1.28)	9.5 (0.61)	7.5 (0.62)	15.1 (1.55)	5.3 (0.26)	9.5 (0.55)	6.5 (0.51)
Lu	1.5 (0.08)	≤ LOD	2.0 (0.15)	1.2 (0.07)	1.0 (0.06)	1.9 (0.14)	0.8 (0.05)	1.3 (0.06)	0.8 (0.06)
∑REE + Y	448.4 (8.2)	63.2 (2.3)	574.7 (7.0)	293.6 (4.8)	249.1 (4.2)	590.3 (10.9)	190.0 (2.7)	316.6 (4.1)	204.6 (4.0)
$(La/Lu)_{CN}$	1.62 (0.61)	1.87 (0.66)	1.56 (0.55)	1.93 (0.63)	1.75 (0.67)	1.58 (0.53)	1.82 (0.57)	1.88 (0.52)	1.79 (0.59)
$(La/Sm)_{CN}$	0.80 (0.34)	18.65 (8.46)	0.92 (0.32)	1.86 (0.64)	1.43 (0.58)	0.67 (0.26)	1.87 (0.55)	2.13 (0.54)	1.56 (0.68)
$(La/Y)_{CN}$	1.05 (0.38)	3.16 (0.95)	0.90 (0.32)	1.35 (0.41)	1.41 (0.58)	0.88 (0.25)	1.59 (0.50)	1.44 (0.39)	1.50 (0.53)
Eu_A = Eu/Eu*	9.06 (1.29)	274.87 (76.34)	10.87 (1.16)	19.94 (2.61)	16.19 (2.41)	5.88 (1.07)	29.65 (3.08)	32.23 (2.49)	21.45 (4.91)
Ce_A = Ce/Ce*	0.87 (0.14)	0.44 (0.05)	0.88 (0.10)	0.80 (0.08)	0.77 (0.11)	0.88 (0.10)	0.70 (0.06)	0.73 (0.05)	0.76 (0.07)

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TABLE C30. *(continued)*

Sample (ppm)	OV-05-01B_14	OV-05-01B_15	OV-05-01B_16	OV-05-01B_17	OV-05-01B_18	OV-05-01B_18	OV-05-01B_19	OV-05-01B_19	OV-05-01B_20
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	7.0 (0.6)	7.3 (0.6)	7.2 (0.5)	6.8 (0.6)	4.7 (0.9)	5.8 (0.9)	7.0 (1.1)	7.2 (1.0)	7.2 (0.8)
Sr	871.1 (31.1)	810.7 (44.7)	793.9 (20.8)	686.0 (23.6)	542.9 (38.4)	622.4 (35.8)	756.7 (50.2)	786.3 (39.1)	754.1 (28.9)
Y	46.5 (1.8)	613.0 (33.3)	48.3 (1.9)	118.1 (9.2)	148.2 (10.9)	112.1 (7.9)	133.7 (9.5)	143.6 (9.5)	101.7 (5.0)
Nb	≤ LOD	5 (0.4)	≤ LOD	1 (0.2)	≤ LOD	≤ LOD	1 (0.2)	1 (0.2)	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Pb	15 (1)	16 (1)	16 (1)	14 (1)	13 (2)	15 (2)	14 (2)	16 (1)	16 (1)
La	12.4 (0.45)	50.2 (3.28)	13.1 (0.35)	22.3 (1.43)	22.9 (0.79)	24.4 (1.19)	20.5 (1.37)	22.8 (0.89)	20.9 (0.64)
Ce	14.2 (0.49)	166.1 (9.56)	15.7 (0.54)	36.0 (2.86)	40.5 (3.13)	34.3 (1.38)	40.3 (4.07)	44.5 (1.92)	32.0 (1.15)
Pr	1.7 (0.07)	32.6 (1.78)	1.9 (0.06)	4.8 (0.37)	6.1 (0.23)	4.6 (0.36)	6.4 (0.73)	6.8 (0.27)	4.2 (0.24)
Nd	6.6 (0.28)	176.5 (8.39)	7.1 (0.31)	20.1 (1.75)	27.9 (1.69)	21.1 (1.71)	28.4 (3.15)	33.4 (1.90)	18.2 (1.23)
Sm	3.1 (0.17)	99.5 (5.16)	3.6 (0.21)	10.5 (0.72)	16.8 (1.88)	11.2 (1.11)	16.3 (1.31)	18.1 (0.82)	8.5 (0.47)
Eu	48.58 (1.83)	155.51 (6.03)	43.03 (1.65)	79.55 (3.20)	78.56 (9.87)	86.66 (4.69)	70.92 (5.95)	73.74 (2.16)	69.56 (3.00)
Gd	4.8 (0.15)	158.3 (11.74)	5.6 (0.30)	16.0 (1.48)	27.8 (3.41)	16.2 (1.68)	23.6 (2.41)	27.9 (1.35)	12.5 (0.78)
Tb	0.9 (0.04)	25.0 (1.64)	0.9 (0.05)	2.5 (0.18)	4.3 (0.46)	2.6 (0.25)	3.6 (0.33)	4.6 (0.18)	2.1 (0.15)
Dy	5.0 (0.21)	133.2 (9.65)	5.6 (0.38)	15.0 (1.36)	25.3 (2.20)	15.6 (1.50)	20.9 (1.81)	25.4 (0.88)	12.7 (0.82)
Ho	0.9 (0.05)	20.6 (1.39)	1.0 (0.06)	2.6 (0.23)	4.2 (0.60)	2.5 (0.15)	3.3 (0.36)	4.0 (0.18)	2.2 (0.11)
Er	2.9 (0.17)	52.1 (3.47)	2.9 (0.16)	7.5 (0.66)	11.5 (1.34)	8.0 (0.55)	10.0 (1.20)	11.0 (0.63)	6.9 (0.36)
Tm	0.6 (0.03)	6.7 (0.41)	0.6 (0.03)	1.2 (0.10)	1.6 (0.18)	1.2 (0.10)	1.5 (0.21)	1.6 (0.08)	1.1 (0.06)
Yb	4.8 (0.22)	36.0 (2.08)	4.6 (0.20)	9.0 (0.66)	11.0 (1.02)	9.2 (0.67)	10.0 (1.09)	11.0 (0.44)	8.5 (0.30)
Lu	0.7 (0.03)	3.5 (0.17)	0.6 (0.03)	1.1 (0.09)	1.4 (0.19)	1.2 (0.06)	1.3 (0.08)	1.4 (0.07)	1.1 (0.04)
∑REE + Y	153.5 (2.0)	1728.8 (22.2)	154.5 (1.9)	346.2 (5.4)	428.4 (11.6)	350.8 (6.0)	390.7 (8.8)	429.8 (4.1)	302.2 (3.7)
$(La/Lu)_{CN}$	1.90 (0.56)	1.47 (0.49)	2.15 (0.61)	2.01 (0.76)	1.69 (0.70)	2.09 (0.67)	1.67 (0.60)	1.63 (0.48)	1.89 (0.49)
$(La/Sm)_{CN}$	2.47 (0.75)	0.32 (0.11)	2.31 (0.68)	1.33 (0.49)	0.85 (0.33)	1.36 (0.52)	0.79 (0.30)	0.79 (0.23)	1.54 (0.45)
$(La/Y)_{CN}$	1.76 (0.48)	0.54 (0.19)	1.80 (0.46)	1.25 (0.47)	1.03 (0.34)	1.44 (0.50)	1.02 (0.38)	1.05 (0.34)	1.37 (0.39)
$Eu_A = Eu/Eu^*$	37.75 (2.89)	3.75 (0.39)	29.27 (2.67)	18.63 (2.37)	10.96 (2.32)	19.53 (3.04)	10.97 (1.73)	9.95 (0.77)	20.43 (1.99)
$Ce_A = Ce/Ce^*$	0.66 (0.05)	0.95 (0.10)	0.68 (0.04)	0.80 (0.11)	0.81 (0.08)	0.73 (0.07)	0.84 (0.14)	0.85 (0.07)	0.78 (0.06)

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TABLE C30. *(continued)*

Sample (ppm)	OV-05-01B_21	OV-05-01B_2	OV-05-01B_2	OV-05-01B_10	OV-05-01B_10
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	7.2 (0.6)	7.1 (0.5)	7.3 (0.9)	6.4 (0.6)	6.5 (0.6)
Sr	794.4 (31.8)	996.6 (56.2)	1019.0 (85.2)	857.3 (32.3)	892.2 (36.8)
Y	153.9 (5.9)	81.3 (3.4)	53.1 (2.6)	141.2 (14.3)	114.5 (5.3)
Nb	1 (0.3)	≤ LOD	≤ LOD	1 (0.2)	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Pb	17 (1)	20 (1)	26 (2)	20 (1)	27 (2)
La	25.1 (0.76)	16.0 (1.32)	12.2 (0.68)	23.6 (1.72)	19.6 (0.68)
Ce	44.3 (1.70)	23.3 (1.76)	16.9 (0.82)	41.5 (2.84)	32.0 (1.29)
Pr	6.9 (0.25)	2.8 (0.16)	1.9 (0.13)	5.9 (0.37)	4.6 (0.19)
Nd	31.2 (1.31)	11.5 (0.43)	7.4 (0.52)	25.5 (2.46)	19.9 (0.86)
Sm	17.0 (0.68)	5.6 (0.27)	3.1 (0.19)	13.1 (1.19)	10.2 (0.49)
Eu	80.29 (2.48)	45.14 (2.11)	41.64 (3.22)	56.84 (2.92)	52.77 (2.32)
Gd	27.0 (1.58)	7.9 (0.54)	5.1 (0.42)	22.4 (1.92)	17.0 (0.75)
Tb	4.2 (0.21)	1.3 (0.10)	0.9 (0.08)	3.5 (0.22)	2.9 (0.15)
Dy	23.5 (1.11)	8.5 (0.64)	5.5 (0.51)	20.9 (2.10)	16.9 (0.88)
Ho	4.0 (0.24)	1.5 (0.10)	1.0 (0.10)	3.6 (0.33)	2.9 (0.15)
Er	11.4 (0.48)	4.4 (0.34)	2.9 (0.24)	10.1 (0.84)	8.2 (0.44)
Tm	1.7 (0.08)	0.8 (0.05)	0.5 (0.05)	1.5 (0.09)	1.2 (0.05)
Yb	12.6 (0.40)	6.4 (0.34)	4.7 (0.39)	9.7 (0.57)	8.5 (0.39)
Lu	1.5 (0.04)	0.8 (0.04)	0.7 (0.06)	1.4 (0.08)	1.1 (0.06)
∑REE + Y	444.6 (4.0)	217.2 (3.2)	157.5 (3.5)	380.8 (6.0)	312.3 (3.2)
$(La/Lu)_{CN}$	1.71 (0.41)	1.97 (0.72)	1.83 (0.70)	1.78 (0.64)	1.79 (0.51)
$(La/Sm)_{CN}$	0.93 (0.25)	1.78 (0.64)	2.50 (0.86)	1.13 (0.46)	1.20 (0.34)
$(La/Y)_{CN}$	1.08 (0.28)	1.31 (0.46)	1.53 (0.50)	1.11 (0.46)	1.14 (0.32)
Eu_A = Eu/Eu*	11.35 (0.95)	20.59 (2.05)	31.88 (4.29)	10.01 (1.38)	12.10 (1.00)
Ce_A = Ce/Ce*	0.79 (0.06)	0.78 (0.11)	0.77 (0.08)	0.83 (0.10)	0.79 (0.06)

TABLE C31. Barewood, New Zealand (M6616).

Sample (ppm)	M6616_S_1	M6616_S_2	M6616_S_3	M6616_S_4	M6616_S_5	M6616_S_6	M6616_S_7	M6616_S_8	M6616_S_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	4446.0 (50.0)	3835.0 (58.0)	3242.0 (46.0)	4360.0 (140.0)	3788.0 (74.0)	5172.0 (87.0)	3810.0 (77.0)	3611.0 (59.0)	4578.0 (74.0)
Y	32.1 (0.4)	45.1 (0.7)	28.7 (0.5)	105.3 (7.4)	42.7 (1.1)	47.2 (0.8)	18.6 (0.4)	35.1 (1.0)	35.2 (0.9)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	785000 (11000)	783000 (13000)	776000 (13000)	781000 (14000)	782000 (16000)	773000 (13000)	780000 (16000)	776000 (12000)	779000 (16000)
La	8.2 (0.14)	12.4 (0.21)	6.2 (0.10)	22.7 (0.80)	10.8 (0.31)	13.7 (0.21)	6.7 (0.13)	7.6 (0.17)	9.8 (0.18)
Ce	19.2 (0.29)	25.2 (0.43)	15.2 (0.30)	63.7 (4.70)	22.7 (0.68)	22.4 (0.35)	8.0 (0.15)	17.6 (0.59)	19.8 (0.99)
Pr	2.1 (0.06)	2.8 (0.07)	1.7 (0.05)	7.6 (0.62)	2.7 (0.11)	2.1 (0.05)	0.7 (0.03)	2.2 (0.08)	2.3 (0.19)
Nd	7.8 (0.22)	11.0 (0.26)	6.0 (0.23)	30.4 (2.70)	11.7 (0.40)	7.0 (0.22)	2.2 (0.11)	9.2 (0.44)	9.5 (1.30)
Sm	1.5 (0.12)	2.1 (0.10)	1.1 (0.09)	5.9 (0.57)	2.5 (0.14)	1.2 (0.08)	≤ LOD	1.9 (0.12)	2.1 (0.36)
Eu	1.94 (0.06)	2.91 (0.08)	1.91 (0.06)	7.83 (0.68)	3.95 (0.13)	3.03 (0.08)	1.15 (0.05)	2.40 (0.09)	2.38 (0.11)
Gd	1.7 (0.12)	2.2 (0.14)	1.3 (0.08)	6.6 (0.65)	3.0 (0.13)	1.3 (0.09)	0.4 (0.06)	2.2 (0.17)	2.1 (0.35)
Tb	0.3 (0.02)	0.4 (0.02)	0.2 (0.02)	1.1 (0.11)	0.5 (0.02)	0.2 (0.01)	≤ LOD	0.3 (0.03)	0.3 (0.04)
Dy	2.3 (0.09)	2.9 (0.12)	1.9 (0.10)	8.3 (0.79)	3.6 (0.16)	2.0 (0.09)	0.6 (0.04)	2.5 (0.16)	2.3 (0.29)
Ho	0.6 (0.03)	0.8 (0.03)	0.6 (0.03)	2.2 (0.23)	0.8 (0.03)	0.6 (0.02)	≤ LOD	0.7 (0.04)	0.6 (0.05)
Er	2.5 (0.07)	3.3 (0.10)	2.2 (0.07)	8.4 (0.70)	3.1 (0.11)	2.8 (0.09)	1.0 (0.07)	2.8 (0.12)	2.2 (0.13)
Tm	0.4 (0.02)	0.6 (0.03)	0.4 (0.02)	1.3 (0.10)	0.5 (0.02)	0.6 (0.03)	≤ LOD	0.5 (0.02)	0.5 (0.03)
Yb	3.0 (0.11)	5.6 (0.13)	2.7 (0.09)	8.7 (0.30)	4.7 (0.19)	6.2 (0.22)	3.0 (0.14)	3.6 (0.13)	4.2 (0.15)
Lu	0.5 (0.02)	1.1 (0.03)	≤ LOD	1.5 (0.05)	0.9 (0.04)	1.3 (0.04)	0.7 (0.03)	0.6 (0.03)	0.9 (0.04)
∑REE + Y	84.2 (0.5)	118.3 (0.6)	70.5 (0.4)	281.6 (5.7)	114.1 (0.9)	111.5 (0.6)	43.9 (0.3)	89.2 (0.8)	94.0 (1.8)
$(La/Lu)_{CN}$	1.70 (0.42)	1.12 (0.24)	1.46 (0.39)	1.55 (0.41)	1.21 (0.34)	1.09 (0.24)	1.01 (0.25)	1.24 (0.34)	1.14 (0.28)
$(La/Sm)_{CN}$	3.46 (1.09)	3.65 (0.93)	3.58 (1.11)	2.40 (0.87)	2.70 (0.79)	6.95 (1.92)	11.05 (4.30)	2.54 (0.75)	2.92 (1.27)
$(La/Y)_{CN}$	1.69 (0.30)	1.82 (0.32)	1.45 (0.26)	1.44 (0.47)	1.68 (0.39)	1.92 (0.35)	2.39 (0.47)	1.44 (0.32)	1.86 (0.38)
$Eu_A = Eu/Eu^*$	3.67 (0.42)	4.09 (0.35)	4.92 (0.55)	3.77 (0.62)	4.40 (0.37)	7.33 (0.74)	8.59 (1.68)	3.61 (0.40)	3.43 (0.86)
$Ce_A = Ce/Ce^*$	1.08 (0.05)	1.00 (0.05)	1.10 (0.06)	1.16 (0.14)	0.99 (0.07)	0.91 (0.04)	0.74 (0.04)	1.02 (0.06)	0.98 (0.09)

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TABLE C31. *(continued)*

Sample (ppm)	M6616_S_10	M6616_S_11	M6616_S_12	M6616_S_13	M6616_S_14	M6616_S_15	M6616_S_16	M6616_S_17	M6616_S_18
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	3 (0.5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	4288.0 (74.0)	5482.0 (96.0)	6090.0 (130.0)	5630.0 (110.0)	5582.0 (91.0)	5482.0 (72.0)	3655.0 (60.0)	3678.0 (61.0)	5455.0 (63.0)
Y	28.1 (0.6)	44.9 (0.9)	26.7 (1.0)	40.5 (0.9)	86.0 (8.0)	126.0 (18.0)	29.2 (0.5)	36.4 (0.7)	37.7 (0.7)
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0.2)	≤ LOD	≤ LOD
W	780000 (13000)	774000 (16000)	767000 (12000)	770000 (10000)	782000 (10000)	788000 (11000)	799000 (12000)	782000 (11000)	781000 (11000)
La	9.0 (0.14)	14.7 (0.25)	9.8 (0.28)	12.0 (0.17)	21.3 (1.60)	24.4 (2.70)	7.3 (0.11)	9.4 (0.15)	12.1 (0.24)
Ce	13.5 (0.23)	27.4 (0.57)	14.2 (0.64)	22.0 (0.38)	55.7 (6.50)	79.0 (12.00)	18.6 (0.33)	25.1 (0.41)	22.5 (0.52)
Pr	1.1 (0.03)	2.9 (0.10)	1.2 (0.07)	2.2 (0.06)	6.6 (0.91)	10.8 (1.80)	2.5 (0.07)	3.7 (0.09)	2.3 (0.08)
Nd	3.9 (0.16)	10.3 (0.31)	4.0 (0.23)	8.2 (0.27)	27.0 (3.80)	46.4 (7.90)	11.5 (0.38)	17.9 (0.40)	8.6 (0.31)
Sm	0.6 (0.06)	1.8 (0.08)	0.6 (0.07)	1.4 (0.11)	4.9 (0.71)	9.6 (1.70)	2.5 (0.11)	4.0 (0.17)	1.5 (0.10)
Eu	1.86 (0.06)	2.70 (0.09)	1.52 (0.08)	2.29 (0.07)	5.17 (0.56)	7.60 (1.10)	2.22 (0.08)	2.74 (0.07)	2.37 (0.09)
Gd	0.7 (0.07)	1.9 (0.12)	0.7 (0.08)	1.6 (0.12)	4.7 (0.66)	9.8 (1.70)	2.7 (0.10)	4.3 (0.18)	1.5 (0.09)
Tb	≤ LOD	0.3 (0.02)	≤ LOD	0.3 (0.02)	0.8 (0.12)	1.5 (0.27)	0.4 (0.02)	0.6 (0.03)	0.3 (0.02)
Dy	1.1 (0.07)	2.6 (0.12)	1.1 (0.09)	2.2 (0.09)	6.5 (0.87)	11.6 (2.00)	2.8 (0.11)	4.1 (0.16)	2.1 (0.08)
Ho	0.3 (0.02)	0.7 (0.03)	0.3 (0.02)	0.6 (0.03)	1.7 (0.21)	2.9 (0.48)	0.7 (0.03)	0.9 (0.03)	0.6 (0.03)
Er	1.6 (0.08)	3.2 (0.11)	1.5 (0.07)	2.7 (0.11)	6.6 (0.74)	10.9 (1.70)	2.4 (0.08)	3.0 (0.11)	2.4 (0.10)
Tm	0.4 (0.02)	0.6 (0.03)	0.4 (0.02)	0.6 (0.03)	1.2 (0.11)	1.7 (0.24)	0.4 (0.02)	0.5 (0.02)	0.5 (0.02)
Yb	4.0 (0.14)	5.5 (0.19)	4.2 (0.18)	5.1 (0.15)	8.7 (0.50)	11.3 (1.30)	2.7 (0.08)	3.5 (0.12)	4.6 (0.17)
Lu	0.8 (0.03)	1.1 (0.04)	0.9 (0.04)	1.0 (0.04)	1.6 (0.05)	1.9 (0.18)	0.5 (0.02)	0.7 (0.03)	1.0 (0.03)
∑REE + Y	67.0 (0.4)	120.5 (0.8)	67.4 (0.8)	102.7 (0.6)	238.4 (7.9)	355.4 (15.3)	86.2 (0.6)	116.5 (0.7)	100.0 (0.7)
$(La/Lu)_{CN}$	1.13 (0.24)	1.42 (0.33)	1.15 (0.30)	1.20 (0.28)	1.34 (0.44)	1.34 (0.61)	1.47 (0.34)	1.45 (0.33)	1.29 (0.30)
$(La/Sm)_{CN}$	9.22 (3.03)	5.07 (1.26)	10.35 (4.00)	5.27 (1.59)	2.71 (1.27)	1.59 (0.85)	1.85 (0.45)	1.49 (0.36)	4.95 (1.44)
$(La/Y)_{CN}$	2.14 (0.40)	2.17 (0.42)	2.45 (0.63)	1.98 (0.38)	1.65 (0.68)	1.29 (0.65)	1.66 (0.30)	1.71 (0.32)	2.13 (0.42)
$Eu_A = Eu/Eu^*$	8.68 (1.24)	4.42 (0.38)	6.98 (1.23)	4.60 (0.53)	3.21 (0.75)	2.36 (0.69)	2.58 (0.19)	2.00 (0.14)	4.65 (0.47)
$Ce_A = Ce/Ce^*$	0.87 (0.04)	0.96 (0.05)	0.85 (0.07)	0.96 (0.05)	1.12 (0.21)	1.16 (0.30)	1.05 (0.05)	1.02 (0.05)	0.96 (0.05)

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TABLE C31. *(continued)*

Sample (ppm)	M6616_S_19	M6616_S_20
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	1.5 (0.4)	≤ LOD
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD
Sr	5471.0 (62.0)	3037.0 (27.0)
Y	58.1 (0.6)	23.5 (0.3)
Mo	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	767000 (11000)	784000 (11000)
La	14.4 (0.22)	7.1 (0.12)
Ce	30.6 (0.37)	13.2 (0.21)
Pr	4.0 (0.08)	1.3 (0.04)
Nd	19.1 (0.33)	4.7 (0.13)
Sm	5.5 (0.23)	0.9 (0.07)
Eu	5.09 (0.11)	1.37 (0.05)
Gd	6.7 (0.20)	1.0 (0.07)
Tb	1.0 (0.03)	≤ LOD
Dy	6.6 (0.17)	1.2 (0.07)
Ho	1.4 (0.04)	0.3 (0.02)
Er	4.4 (0.10)	1.5 (0.06)
Tm	0.7 (0.02)	0.3 (0.01)
Yb	6.0 (0.16)	3.0 (0.12)
Lu	1.2 (0.03)	0.6 (0.02)
∑REE + Y	164.6 (0.7)	60.1 (0.3)
$(La/Lu)_{CN}$	1.29 (0.26)	1.20 (0.28)
$(La/Sm)_{CN}$	1.64 (0.39)	5.24 (1.65)
$(La/Y)_{CN}$	1.64 (0.26)	2.02 (0.35)
$Eu_A = Eu/Eu^*$	2.56 (0.16)	4.44 (0.53)
$Ce_A = Ce/Ce^*$	0.96 (0.04)	0.97 (0.05)

TABLE C32. Kovárna Mine (Obří dul, Riesengrund), Czech Republic (M6917).

Sample (ppm)	M6917_S_1	M6917_S_2	M6917_S_3	M6917_S_4	M6917_S_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	1 (0.1)	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	71.2 (1.0)	76.0 (1.0)	63.6 (2.1)	55.1 (0.8)	38.6 (0.5)
Y	2.6 (0.1)	1.1 (0.0)	1.4 (0.1)	2.3 (0.1)	0.7 (0.0)
Mo	215 (3.6)	35 (0.7)	33 (0.6)	240 (3.5)	88 (1.6)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	674800 (8700)	675500 (9200)	673500 (8300)	663800 (9100)	686700 (8300)
La	1.3 (0.05)	2.0 (0.05)	0.7 (0.04)	1.2 (0.03)	0.9 (0.03)
Ce	2.3 (0.06)	3.0 (0.07)	0.9 (0.05)	1.7 (0.05)	0.6 (0.03)
Pr	0.2 (0.02)	0.3 (0.01)	≤ LOD	0.2 (0.01)	≤ LOD
Nd	0.8 (0.07)	0.9 (0.05)	0.6 (0.06)	0.6 (0.04)	≤ LOD
Sm	≤ LOD	≤ LOD	0.5 (0.07)	≤ LOD	≤ LOD
Eu	0.29 (0.02)	0.25 (0.02)	0.14 (0.02)	0.22 (0.01)	0.72 (0.03)
Gd	≤ LOD	≤ LOD	0.9 (0.10)	≤ LOD	≤ LOD
Tb	≤ LOD	≤ LOD	0.2 (0.02)	≤ LOD	≤ LOD
Dy	≤ LOD	≤ LOD	0.8 (0.09)	≤ LOD	≤ LOD
Ho	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Er	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Tm	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Yb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	8.7 (0.1)	8.3 (0.1)	6.7 (0.2)	7.1 (0.1)	3.3 (0.1)
$(La/Lu)_{CN}$	6.12 (2.80)	16.00 (7.72)	16.96 (10.64)	4.05 (1.67)	6.62 (3.01)
$(La/Sm)_{CN}$	4.91 (2.18)	7.62 (3.36)	0.94 (0.42)	6.73 (3.14)	32.90 (23.67)
$(La/Y)_{CN}$	3.47 (0.89)	11.73 (2.80)	3.40 (1.13)	3.41 (0.82)	9.24 (2.67)
$Eu_A = Eu/Eu^*$	4.82 (1.12)	4.31 (1.08)	0.64 (0.14)	5.40 (1.57)	156.68 (126.39)
$Ce_A = Ce/Ce^*$	0.92 (0.07)	0.87 (0.05)	0.68 (0.08)	0.84 (0.06)	0.50 (0.04)

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TABLE C32. *(continued)*

Sample (ppm)	M6917_S_6	M6917_S_7	M6917_S_8	M6917_S_9	M6917_S_10	M6917_S_11	M6917_S_12	M6917_S_13	M6917_S_14
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	151.3 (2.4)	132.0 (2.1)	198.7 (3.5)	156.1 (3.7)	191.4 (2.4)	148.5 (3.6)	135.4 (3.5)	136.1 (2.8)	268.6 (5.1)
Y	128.5 (2.3)	9.8 (0.3)	1.0 (0.0)	1.3 (0.0)	1.8 (0.1)	10.0 (0.2)	7.2 (0.3)	7.2 (0.2)	114.8 (2.1)
Mo	10 (0.3)	16 (0.4)	4 (0.2)	7 (0.2)	4 (0.2)	19 (0.5)	17 (0.6)	16 (0.4)	13 (0.4)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	677300 (9400)	683000 (11000)	677000 (12000)	681000 (17000)	684100 (9900)	662000 (18000)	653000 (12000)	679000 (11000)	669000 (13000)
La	15.0 (0.26)	2.5 (0.07)	36.1 (0.41)	37.4 (0.54)	69.5 (0.78)	4.4 (0.10)	3.0 (0.07)	3.3 (0.07)	53.4 (0.66)
Ce	49.3 (1.30)	4.0 (0.26)	36.4 (0.67)	34.4 (0.69)	104.4 (1.60)	6.7 (0.18)	4.1 (0.13)	4.8 (0.12)	73.1 (1.20)
Pr	7.9 (0.29)	0.4 (0.05)	2.2 (0.05)	1.9 (0.05)	7.7 (0.12)	0.8 (0.03)	0.4 (0.02)	0.5 (0.02)	6.4 (0.15)
Nd	37.9 (1.90)	2.0 (0.31)	4.7 (0.18)	3.6 (0.12)	18.1 (0.42)	3.3 (0.19)	1.5 (0.08)	2.0 (0.10)	20.9 (0.52)
Sm	10.7 (0.55)	0.7 (0.15)	≤ LOD	≤ LOD	1.7 (0.08)	1.0 (0.09)	0.5 (0.04)	0.5 (0.05)	4.3 (0.16)
Eu	21.51 (0.36)	0.88 (0.03)	4.52 (0.11)	2.48 (0.08)	6.44 (0.11)	1.70 (0.06)	0.91 (0.04)	1.03 (0.04)	11.24 (0.27)
Gd	13.1 (0.70)	1.1 (0.23)	0.3 (0.04)	0.2 (0.03)	0.9 (0.05)	1.2 (0.09)	0.6 (0.05)	0.8 (0.06)	4.7 (0.18)
Tb	2.1 (0.10)	0.2 (0.03)	≤ LOD	≤ LOD	≤ LOD	0.2 (0.02)	≤ LOD	≤ LOD	0.8 (0.03)
Dy	14.1 (0.65)	1.3 (0.18)	≤ LOD	≤ LOD	0.6 (0.04)	1.4 (0.07)	0.8 (0.05)	0.9 (0.04)	5.1 (0.17)
Ho	2.7 (0.10)	0.3 (0.03)	≤ LOD	≤ LOD	≤ LOD	0.3 (0.01)	≤ LOD	≤ LOD	1.1 (0.04)
Er	7.1 (0.27)	0.7 (0.05)	≤ LOD	≤ LOD	≤ LOD	0.8 (0.04)	0.5 (0.03)	0.5 (0.03)	4.1 (0.12)
Tm	0.8 (0.03)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.8 (0.02)
Yb	3.5 (0.12)	0.7 (0.04)	≤ LOD	≤ LOD	≤ LOD	0.7 (0.05)	0.6 (0.05)	0.5 (0.04)	7.4 (0.17)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.5 (0.04)
∑REE + Y	314.6 (2.6)	24.6 (0.5)	86.1 (0.8)	82.2 (0.9)	211.9 (1.8)	32.7 (0.3)	20.6 (0.2)	22.5 (0.2)	309.6 (1.5)
$(La/Lu)_{CN}$	3.99 (1.03)	2.66 (0.86)	285.24 (139.94)	201.79 (90.73)	331.41 (122.15)	4.56 (1.55)	3.23 (1.12)	4.22 (1.37)	3.71 (0.72)
$(La/Sm)_{CN}$	0.88 (0.23)	2.31 (1.16)	52.00 (17.27)	73.52 (26.88)	24.95 (6.05)	2.68 (0.87)	4.07 (1.40)	3.74 (1.28)	7.86 (1.76)
$(La/Y)_{CN}$	0.78 (0.15)	1.68 (0.40)	234.26 (53.24)	187.57 (41.98)	262.32 (54.16)	2.93 (0.63)	2.76 (0.68)	3.01 (0.62)	3.09 (0.54)
$Eu_A = Eu/Eu^*$	5.52 (0.44)	3.14 (0.99)	36.25 (5.80)	26.78 (5.03)	13.99 (1.14)	4.69 (0.59)	5.16 (0.70)	4.70 (0.62)	7.57 (0.48)
$Ce_A = Ce/Ce^*$	1.07 (0.07)	0.85 (0.09)	0.68 (0.03)	0.63 (0.03)	0.90 (0.04)	0.81 (0.05)	0.78 (0.05)	0.82 (0.05)	0.81 (0.04)

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TABLE C32. *(continued)*

Sample (ppm)	M6917_S_15	M6917_S_16	M6917_S_17	M6917_S_18	M6917_S_19	M6917_S_20
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	150.4 (3.2)	212.6 (3.6)	238.6 (3.9)	219.4 (3.0)	80.6 (1.6)	185.2 (3.3)
Y	11.7 (0.3)	7.9 (0.2)	21.2 (0.5)	12.4 (0.3)	6.6 (0.1)	2.0 (0.1)
Mo	20 (0.5)	9 (0.4)	7 (0.3)	8 (0.3)	26 (0.7)	4 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	674000 (15000)	691000 (15000)	685000 (11000)	680000 (15000)	672000 (14000)	670000 (13000)
La	5.7 (0.13)	36.2 (0.64)	102.4 (1.40)	46.6 (0.62)	3.4 (0.08)	80.1 (1.30)
Ce	6.6 (0.13)	43.6 (0.78)	182.8 (3.60)	72.5 (1.10)	17.4 (0.31)	78.4 (1.40)
Pr	0.6 (0.03)	3.2 (0.07)	14.8 (0.36)	6.1 (0.15)	3.5 (0.09)	4.3 (0.10)
Nd	2.1 (0.10)	8.0 (0.26)	38.3 (1.10)	17.5 (0.52)	18.7 (0.40)	7.6 (0.22)
Sm	0.5 (0.05)	1.1 (0.07)	5.1 (0.21)	2.7 (0.14)	4.8 (0.19)	0.8 (0.06)
Eu	1.72 (0.07)	5.36 (0.12)	14.23 (0.32)	7.82 (0.15)	1.45 (0.05)	8.30 (0.22)
Gd	0.6 (0.06)	0.9 (0.06)	3.8 (0.17)	2.3 (0.15)	5.6 (0.20)	0.4 (0.05)
Tb	≤ LOD	≤ LOD	0.6 (0.03)	0.3 (0.02)	0.8 (0.03)	≤ LOD
Dy	0.9 (0.05)	0.9 (0.05)	3.8 (0.16)	2.1 (0.10)	4.1 (0.13)	≤ LOD
Ho	≤ LOD	≤ LOD	0.7 (0.03)	0.4 (0.02)	0.7 (0.02)	≤ LOD
Er	0.7 (0.04)	0.6 (0.04)	2.2 (0.07)	1.2 (0.06)	1.2 (0.04)	≤ LOD
Tm	≤ LOD	≤ LOD	0.4 (0.02)	≤ LOD	≤ LOD	≤ LOD
Yb	1.3 (0.07)	0.9 (0.05)	2.3 (0.10)	1.1 (0.07)	≤ LOD	≤ LOD
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	33.2 (0.3)	109.2 (1.1)	392.9 (4.1)	173.5 (1.4)	68.3 (0.6)	182.9 (1.9)
$(La/Lu)_{CN}$	2.43 (0.67)	22.96 (7.17)	31.18 (7.69)	27.56 (7.28)	21.62 (9.85)	262.45 (104.57)
$(La/Sm)_{CN}$	6.75 (2.31)	20.50 (5.74)	12.61 (2.96)	10.79 (2.75)	0.45 (0.11)	65.11 (19.41)
$(La/Y)_{CN}$	3.26 (0.69)	30.45 (6.04)	32.04 (6.02)	25.06 (4.64)	3.43 (0.72)	262.66 (58.10)
Eu_A = Eu/Eu*	8.91 (1.21)	15.95 (1.53)	9.41 (0.66)	9.30 (0.81)	0.85 (0.06)	39.69 (4.94)
Ce_A = Ce/Ce*	0.71 (0.04)	0.76 (0.04)	1.01 (0.05)	0.90 (0.04)	1.07 (0.06)	0.67 (0.03)

TABLE C33. Mackenzie Mine, ON, Canada (ME736).

Sample (ppm)	ME736_S_1	ME736_S_2	ME736_S_3	ME736_S_4	ME736_S_5	ME736_S_6	ME736_S_7	ME736_S_8	ME736_S_9
Li	≤ LOD	≤ LOD	3 (0.2)	3 (0.3)	1 (0.2)	7 (0.3)	≤ LOD	≤ LOD	2 (0.2)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	1.8 (0.2)	5.1 (0.4)	8.5 (0.3)	9.1 (0.3)	6.3 (0.2)	5.2 (0.3)	4.7 (0.3)	5.0 (0.2)	5.9 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	2 (0.2)	≤ LOD	6 (0.4)	3 (0.2)	≤ LOD	2 (0.1)	2 (0.1)	9 (0.5)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	1005.0 (11.0)	1011.0 (13.0)	892.8 (7.2)	845.4 (7.1)	1062.0 (13.0)	1010.0 (11.0)	1042.4 (9.3)	1051.0 (11.0)	1010.0 (12.0)
Y	173.8 (2.5)	246.5 (6.4)	1270.0 (390.0)	421.1 (5.5)	145.2 (3.2)	380.0 (5.1)	236.6 (2.5)	338.4 (7.2)	540.8 (8.7)
Mo	2 (0.1)	3 (0.1)	4 (0.2)	4 (0.2)	3 (0.2)	3 (0.2)	3 (0.2)	3 (0.2)	3 (0.1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	669100 (9100)	662100 (8500)	673200 (7500)	662000 (7500)	657200 (7600)	664100 (7400)	655900 (7600)	650800 (6800)	649200 (9400)
La	6.4 (0.27)	20.8 (0.69)	6.7 (1.20)	5.6 (0.29)	15.9 (0.36)	22.4 (0.31)	15.5 (0.34)	17.9 (0.25)	16.9 (0.33)
Ce	41.2 (1.20)	42.9 (1.40)	35.0 (3.30)	37.3 (0.97)	23.7 (0.51)	88.0 (1.30)	49.2 (0.81)	78.1 (1.10)	92.7 (1.30)
Pr	10.4 (0.24)	4.5 (0.15)	10.2 (0.56)	10.3 (0.20)	2.3 (0.06)	14.3 (0.21)	6.4 (0.08)	12.6 (0.19)	19.5 (0.32)
Nd	82.7 (1.50)	16.6 (0.52)	95.4 (4.20)	89.5 (1.40)	8.7 (0.20)	75.5 (1.20)	27.7 (0.46)	62.7 (1.20)	125.2 (1.60)
Sm	46.2 (0.67)	5.7 (0.20)	79.4 (8.50)	58.2 (0.81)	3.7 (0.14)	24.7 (0.49)	9.1 (0.27)	22.5 (0.40)	54.3 (0.95)
Eu	19.99 (0.31)	35.89 (0.65)	30.90 (2.60)	24.11 (0.30)	27.12 (0.38)	38.13 (0.47)	29.14 (0.35)	39.39 (0.52)	43.02 (0.53)
Gd	78.6 (1.20)	9.1 (0.31)	206.0 (32.00)	124.4 (1.60)	5.9 (0.17)	37.8 (0.45)	14.0 (0.48)	34.0 (0.81)	87.9 (1.10)
Tb	13.7 (0.22)	2.3 (0.07)	47.2 (9.90)	24.0 (0.31)	1.3 (0.03)	7.9 (0.10)	3.2 (0.11)	7.4 (0.16)	17.6 (0.24)
Dy	81.3 (1.20)	21.1 (0.69)	375.0 (91.00)	158.8 (2.10)	11.6 (0.26)	62.5 (0.79)	26.9 (0.59)	57.9 (1.10)	126.6 (1.70)
Ho	11.5 (0.21)	4.8 (0.16)	67.0 (17.00)	25.2 (0.33)	2.7 (0.06)	12.9 (0.16)	5.8 (0.12)	11.2 (0.26)	23.2 (0.34)
Er	21.0 (0.33)	18.7 (0.51)	141.0 (39.00)	49.3 (0.54)	11.2 (0.26)	38.4 (0.40)	20.3 (0.30)	32.1 (0.72)	60.0 (0.75)
Tm	1.8 (0.05)	3.8 (0.11)	14.6 (4.40)	4.3 (0.09)	2.4 (0.07)	5.4 (0.08)	3.5 (0.06)	4.3 (0.12)	7.2 (0.10)
Yb	6.5 (0.17)	29.4 (0.80)	60.0 (20.00)	14.6 (0.28)	21.4 (0.62)	29.6 (0.49)	21.9 (0.33)	22.7 (0.54)	35.5 (0.49)
Lu	≤ LOD	3.7 (0.09)	3.8 (1.20)	0.8 (0.02)	3.0 (0.09)	3.1 (0.06)	2.3 (0.05)	2.1 (0.08)	3.3 (0.06)
∑REE + Y	595.4 (2.7)	465.7 (2.2)	2442.2 (108.4)	1047.5 (3.4)	286.1 (1.1)	840.6 (2.2)	471.6 (1.4)	743.3 (2.4)	1253.7 (3.3)
$(La/Lu)_{CN}$	1.47 (0.42)	0.59 (0.14)	0.18 (0.13)	0.71 (0.20)	0.56 (0.13)	0.75 (0.14)	0.69 (0.14)	0.88 (0.20)	0.53 (0.10)
$(La/Sm)_{CN}$	0.09 (0.02)	2.30 (0.60)	0.05 (0.03)	0.06 (0.02)	2.67 (0.65)	0.57 (0.10)	1.06 (0.24)	0.50 (0.09)	0.20 (0.04)
$(La/Y)_{CN}$	0.24 (0.06)	0.56 (0.14)	0.04 (0.02)	0.09 (0.02)	0.73 (0.15)	0.39 (0.06)	0.43 (0.08)	0.35 (0.07)	0.21 (0.04)
Eu_A = Eu/Eu*	1.00 (0.04)	15.06 (0.87)	0.70 (0.16)	0.84 (0.03)	17.46 (0.95)	3.78 (0.14)	7.80 (0.42)	4.31 (0.18)	1.88 (0.07)
Ce_A = Ce/Ce*	0.95 (0.06)	1.02 (0.07)	0.81 (0.12)	0.89 (0.06)	0.85 (0.05)	1.14 (0.05)	1.18 (0.05)	1.19 (0.06)	1.06 (0.05)

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TABLE C33. *(continued)*

Sample (ppm)	ME736_S_10	ME736_S_11	ME736_S_12	ME736_S_13	ME736_S_14	ME736_S_15	ME736_S_16	ME736_S_17	ME736_S_18
Li	3 (0.3)	1 (0.2)	3 (0.2)	2 (0.3)	≤ LOD	5 (0.3)	4 (0.3)	3 (0.3)	6 (0.3)
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	5.1 (0.3)	5.4 (0.3)	4.9 (0.3)	6.1 (0.3)	4.8 (0.3)	5.2 (0.3)	4.5 (0.3)	5.0 (0.3)	5.9 (0.3)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	3 (0.2)	3 (0.2)	2 (0.2)	2 (0.1)	2 (0.2)	3 (0.2)	4 (0.4)	2 (0.2)	3 (0.2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	1020.0 (11.0)	914.0 (12.0)	1002.0 (13.0)	992.0 (11.0)	1100.0 (14.0)	1039.0 (12.0)	962.0 (12.0)	976.2 (9.9)	1016.0 (13.0)
Y	439.0 (14.0)	448.5 (5.5)	401.5 (9.8)	547.1 (8.0)	238.9 (3.3)	485.2 (7.2)	494.4 (7.2)	358.8 (5.8)	479.0 (10.0)
Mo	3 (0.2)	4 (0.2)	3 (0.2)	3 (0.1)	3 (0.1)	3 (0.1)	3 (0.1)	3 (0.2)	3 (0.2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	652200 (7600)	649700 (7800)	650200 (9500)	647800 (8400)	658400 (9400)	651400 (8900)	647000 (9400)	653700 (7900)	643400 (8700)
La	11.6 (0.82)	5.8 (0.10)	21.8 (2.60)	26.8 (0.63)	14.1 (0.23)	30.2 (0.38)	16.7 (2.00)	11.4 (0.51)	21.5 (2.90)
Ce	73.9 (2.00)	35.7 (0.47)	75.0 (6.00)	107.3 (2.20)	54.0 (0.82)	104.9 (1.40)	75.4 (4.10)	51.8 (1.60)	104.0 (8.60)
Pr	16.6 (0.41)	9.6 (0.13)	11.6 (0.78)	18.0 (0.29)	8.9 (0.15)	15.1 (0.22)	14.8 (0.47)	9.1 (0.26)	20.2 (1.10)
Nd	109.6 (2.40)	86.2 (1.10)	57.7 (2.40)	97.8 (1.60)	47.4 (1.10)	72.5 (1.30)	94.4 (2.20)	48.0 (0.97)	125.9 (4.10)
Sm	44.2 (0.98)	59.7 (0.90)	22.9 (0.93)	39.1 (0.70)	21.9 (0.80)	26.2 (0.57)	46.3 (0.79)	21.1 (0.43)	49.6 (1.20)
Eu	39.35 (0.42)	21.63 (0.37)	50.58 (0.91)	53.13 (0.68)	41.63 (0.57)	42.88 (0.67)	46.94 (0.64)	46.61 (0.69)	40.56 (0.67)
Gd	67.7 (1.50)	133.3 (2.00)	37.0 (1.40)	64.1 (0.96)	32.3 (1.10)	41.3 (0.87)	81.5 (1.30)	35.9 (0.62)	74.2 (1.40)
Tb	13.2 (0.33)	25.6 (0.37)	8.2 (0.31)	13.8 (0.18)	6.4 (0.18)	9.3 (0.19)	16.7 (0.24)	8.3 (0.14)	14.5 (0.28)
Dy	95.8 (2.40)	168.3 (2.20)	64.0 (2.00)	103.8 (1.40)	43.6 (1.10)	74.4 (1.40)	118.5 (1.60)	65.2 (0.91)	103.9 (1.70)
Ho	17.9 (0.51)	27.2 (0.35)	12.9 (0.39)	20.0 (0.23)	7.8 (0.18)	15.0 (0.22)	21.2 (0.29)	12.4 (0.18)	19.2 (0.34)
Er	47.4 (1.20)	53.2 (0.63)	37.9 (0.97)	55.8 (0.70)	20.9 (0.54)	46.1 (0.62)	53.0 (0.72)	35.1 (0.57)	50.9 (0.95)
Tm	5.9 (0.19)	4.6 (0.06)	5.5 (0.13)	7.3 (0.10)	3.1 (0.07)	7.0 (0.11)	6.4 (0.12)	4.6 (0.08)	6.6 (0.13)
Yb	30.0 (1.20)	15.6 (0.31)	31.5 (0.76)	38.6 (0.70)	18.0 (0.34)	41.1 (0.53)	31.1 (0.55)	23.9 (0.46)	33.7 (0.77)
Lu	2.8 (0.11)	1.0 (0.02)	3.4 (0.10)	3.9 (0.08)	1.8 (0.04)	4.2 (0.08)	2.8 (0.06)	2.3 (0.06)	3.3 (0.09)
∑REE + Y	1015.1 (4.8)	1095.8 (3.5)	841.4 (7.7)	1196.5 (3.6)	560.7 (2.4)	1015.4 (2.8)	1120.2 (5.7)	734.6 (2.5)	1147.0 (10.4)
$(La/Lu)_{CN}$	0.42 (0.14)	0.63 (0.13)	0.67 (0.26)	0.71 (0.15)	0.82 (0.16)	0.74 (0.13)	0.61 (0.23)	0.51 (0.13)	0.67 (0.27)
$(La/Sm)_{CN}$	0.16 (0.05)	0.06 (0.01)	0.60 (0.24)	0.43 (0.09)	0.40 (0.09)	0.72 (0.13)	0.23 (0.08)	0.34 (0.09)	0.27 (0.11)
$(La/Y)_{CN}$	0.18 (0.06)	0.09 (0.01)	0.36 (0.14)	0.32 (0.06)	0.39 (0.07)	0.41 (0.07)	0.22 (0.08)	0.21 (0.05)	0.30 (0.12)
$Eu_A = Eu/Eu^*$	2.18 (0.09)	0.71 (0.03)	5.25 (0.33)	3.21 (0.12)	4.74 (0.27)	3.94 (0.17)	2.30 (0.08)	5.10 (0.20)	2.03 (0.09)
$Ce_A = Ce/Ce^*$	1.04 (0.07)	0.89 (0.05)	1.11 (0.17)	1.13 (0.06)	1.12 (0.05)	1.17 (0.05)	1.05 (0.11)	1.14 (0.08)	1.08 (0.15)

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TABLE C33. *(continued)*

Sample (ppm)	ME736_S_19	ME736_S_20
Li	7 (0.3)	5 (0.3)
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	8.9 (0.4)	5.5 (0.4)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD
As	8 (0.4)	1 (0.1)
Rb	≤ LOD	≤ LOD
Sr	876.0 (11.0)	986.8 (8.3)
Y	551.0 (12.0)	494.0 (19.0)
Mo	4 (0.2)	3 (0.1)
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD
W	650500 (8200)	654400 (8500)
La	10.5 (1.50)	28.0 (0.53)
Ce	57.4 (6.00)	96.0 (1.90)
Pr	13.5 (0.93)	14.7 (0.41)
Nd	107.6 (5.20)	73.2 (2.30)
Sm	66.7 (2.50)	30.3 (1.20)
Eu	24.49 (0.35)	52.50 (1.00)
Gd	134.8 (2.30)	49.9 (1.60)
Tb	26.4 (0.47)	11.4 (0.45)
Dy	184.5 (3.10)	88.7 (4.30)
Ho	30.7 (0.51)	16.8 (0.71)
Er	63.7 (1.10)	46.8 (1.60)
Tm	6.0 (0.14)	6.7 (0.28)
Yb	21.2 (0.56)	38.3 (2.80)
Lu	1.2 (0.04)	3.8 (0.20)
∑REE + Y	1299.7 (9.5)	1050.9 (6.6)
$(La/Lu)_{CN}$	0.87 (0.37)	0.77 (0.21)
$(La/Sm)_{CN}$	0.10 (0.04)	0.58 (0.14)
$(La/Y)_{CN}$	0.13 (0.05)	0.38 (0.09)
Eu_A = Eu/Eu*	0.77 (0.04)	4.08 (0.24)
Ce_A = Ce/Ce*	0.97 (0.16)	1.12 (0.06)

TABLE C34. Silverton, Colorado, USA (ME747).

Sample (ppm)	ME747_S_1	ME747_S_2	ME747_S_3	ME747_S_4	ME747_S_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	34.8 (0.6)	39.6 (0.6)	30.2 (0.6)	31.5 (0.8)	18.6 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	1 (0.1)	2 (0.1)	1 (0.1)	2 (0.2)	5 (0.3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	1679.0 (17.0)	1690.0 (21.0)	1642.0 (23.0)	1622.0 (18.0)	958.0 (11.0)
Y	168.5 (1.9)	144.1 (1.3)	185.1 (2.1)	160.6 (1.5)	221.7 (2.1)
Mo	218 (2.8)	219 (2.5)	208 (3.5)	203 (2.8)	192 (4.5)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	730000 (11000)	742000 (10000)	746300 (8900)	749000 (12000)	754000 (10000)
La	108.6 (1.50)	95.8 (1.20)	115.3 (1.40)	114.1 (1.50)	15.2 (0.20)
Ce	206.3 (3.00)	189.2 (2.80)	252.9 (3.00)	256.4 (3.30)	121.2 (1.50)
Pr	21.0 (0.29)	19.7 (0.29)	28.7 (0.32)	29.3 (0.34)	28.1 (0.33)
Nd	71.9 (0.95)	67.8 (0.91)	110.3 (1.40)	114.0 (1.40)	160.5 (2.30)
Sm	13.7 (0.25)	13.0 (0.27)	22.4 (0.42)	24.2 (0.39)	56.8 (0.77)
Eu	14.05 (0.16)	12.53 (0.18)	15.58 (0.28)	14.06 (0.21)	31.54 (0.43)
Gd	12.1 (0.31)	11.2 (0.27)	19.5 (0.30)	19.8 (0.36)	54.9 (0.91)
Tb	2.9 (0.05)	2.6 (0.04)	4.1 (0.06)	4.0 (0.07)	8.4 (0.12)
Dy	32.2 (0.50)	27.9 (0.40)	41.4 (0.66)	37.7 (0.55)	53.6 (0.67)
Ho	8.8 (0.12)	7.4 (0.10)	10.8 (0.15)	9.7 (0.13)	9.8 (0.11)
Er	37.3 (0.57)	31.1 (0.32)	43.1 (0.43)	37.9 (0.42)	26.9 (0.30)
Tm	8.4 (0.14)	6.9 (0.10)	9.0 (0.09)	7.7 (0.10)	3.7 (0.06)
Yb	69.5 (1.00)	54.8 (0.77)	70.6 (0.86)	60.7 (0.73)	20.6 (0.30)
Lu	9.3 (0.14)	7.1 (0.11)	9.1 (0.11)	7.6 (0.09)	2.0 (0.04)
∑REE + Y	784.4 (3.7)	690.9 (3.4)	937.8 (3.8)	897.7 (4.1)	815.0 (3.2)
$(La/Lu)_{CN}$	1.21 (0.21)	1.41 (0.24)	1.31 (0.20)	1.55 (0.24)	0.80 (0.14)
$(La/Sm)_{CN}$	4.98 (0.89)	4.61 (0.84)	3.22 (0.57)	2.96 (0.51)	0.17 (0.03)
$(La/Y)_{CN}$	4.28 (0.68)	4.42 (0.65)	4.14 (0.63)	4.72 (0.71)	0.46 (0.07)
Eu_A = Eu/Eu*	3.25 (0.13)	3.08 (0.13)	2.21 (0.09)	1.90 (0.07)	1.69 (0.06)
Ce_A = Ce/Ce*	0.98 (0.04)	1.00 (0.04)	1.03 (0.04)	1.04 (0.04)	1.06 (0.05)

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TABLE C34. *(continued)*

Sample (ppm)	ME747_S_6	ME747_S_7	ME747_S_8	ME747_S_9	ME747_S_10	ME747_S_11	ME747_S_12	ME747_S_13	ME747_S_14	ME747_S_15
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	31.1 (0.6)	27.3 (0.5)	30.5 (0.6)	30.2 (0.6)	28.9 (0.6)	35.6 (0.7)	30.2 (0.4)	28.7 (0.6)	29.3 (0.4)	31.3 (0.7)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	≤ LOD	1 (0.2)	1 (0.1)	1 (0.1)	1 (0.2)	≤ LOD	≤ LOD	≤ LOD	1 (0.1)	2 (0.1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	1655.0 (15.0)	1585.0 (17.0)	1637.0 (19.0)	1637.0 (16.0)	1656.0 (20.0)	1771.0 (18.0)	1620.0 (22.0)	1634.0 (16.0)	1660.0 (15.0)	1747.0 (18.0)
Y	125.5 (1.2)	124.1 (1.4)	204.7 (2.5)	174.0 (1.6)	189.6 (2.3)	112.5 (1.6)	128.6 (1.6)	153.2 (1.7)	218.0 (2.3)	199.9 (2.0)
Mo	213 (2.8)	195 (3.0)	204 (3.9)	190 (3.1)	193 (2.9)	218 (2.2)	195 (2.4)	177 (2.4)	213 (2.2)	211 (2.7)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ba	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	740100 (8800)	759000 (10000)	763000 (10000)	761000 (11000)	761700 (7900)	756900 (9100)	762600 (9100)	764600 (9300)	761000 (8700)	767000 (10000)
La	89.4 (0.76)	71.9 (0.85)	99.5 (1.20)	91.6 (0.96)	81.0 (0.95)	43.3 (0.61)	54.6 (0.74)	76.7 (0.73)	96.7 (0.80)	101.8 (0.90)
Ce	180.7 (2.20)	156.5 (2.10)	219.6 (2.80)	194.9 (1.90)	177.9 (2.30)	104.7 (1.30)	117.9 (1.60)	156.7 (1.80)	210.0 (2.40)	229.9 (2.20)
Pr	18.2 (0.23)	17.1 (0.23)	25.7 (0.35)	22.5 (0.28)	22.0 (0.32)	13.4 (0.21)	14.6 (0.21)	18.4 (0.23)	24.7 (0.28)	27.1 (0.34)
Nd	56.3 (0.94)	58.7 (0.86)	101.2 (1.50)	86.5 (1.10)	86.6 (1.30)	54.0 (0.84)	60.2 (0.92)	72.4 (0.77)	95.8 (1.30)	105.1 (1.30)
Sm	9.1 (0.22)	11.6 (0.30)	22.6 (0.32)	18.9 (0.35)	20.4 (0.33)	12.8 (0.28)	16.3 (0.40)	16.8 (0.27)	22.5 (0.34)	23.1 (0.34)
Eu	10.78 (0.18)	11.67 (0.18)	16.69 (0.22)	13.56 (0.19)	15.70 (0.24)	10.72 (0.17)	12.09 (0.22)	13.90 (0.15)	21.48 (0.23)	17.43 (0.22)
Gd	7.3 (0.19)	10.3 (0.23)	19.7 (0.32)	16.6 (0.36)	18.7 (0.35)	11.1 (0.28)	15.3 (0.42)	15.2 (0.32)	20.6 (0.37)	20.2 (0.36)
Tb	1.6 (0.03)	2.2 (0.03)	4.4 (0.07)	3.8 (0.05)	4.3 (0.06)	2.5 (0.06)	3.3 (0.06)	3.4 (0.05)	4.4 (0.06)	4.3 (0.07)
Dy	17.7 (0.21)	21.5 (0.32)	46.5 (0.66)	40.0 (0.55)	45.1 (0.49)	26.1 (0.57)	32.1 (0.44)	34.8 (0.56)	42.6 (0.53)	44.1 (0.55)
Ho	5.0 (0.08)	5.7 (0.08)	12.3 (0.15)	10.6 (0.14)	11.9 (0.16)	6.7 (0.15)	8.1 (0.13)	9.2 (0.10)	10.8 (0.13)	11.6 (0.14)
Er	23.5 (0.35)	25.0 (0.35)	48.8 (0.52)	42.4 (0.58)	47.5 (0.42)	26.7 (0.49)	32.4 (0.47)	37.9 (0.39)	44.2 (0.53)	45.8 (0.37)
Tm	5.9 (0.10)	5.9 (0.09)	10.1 (0.12)	9.0 (0.11)	9.9 (0.10)	5.5 (0.08)	6.9 (0.11)	8.8 (0.09)	10.1 (0.12)	9.4 (0.11)
Yb	52.8 (0.63)	50.4 (0.76)	77.3 (1.10)	71.2 (0.94)	78.9 (0.73)	43.1 (0.77)	56.6 (0.80)	75.3 (0.76)	83.9 (0.89)	72.0 (0.83)
Lu	7.2 (0.10)	6.6 (0.10)	9.7 (0.13)	9.3 (0.11)	10.3 (0.13)	5.6 (0.11)	7.5 (0.14)	10.3 (0.14)	11.2 (0.12)	9.0 (0.11)
∑REE + Y	611.0 (2.7)	579.1 (2.6)	918.7 (3.7)	804.8 (2.8)	819.9 (3.0)	478.6 (2.0)	566.4 (2.3)	703.0 (2.4)	916.9 (3.1)	920.5 (3.0)
$(La/Lu)_{CN}$	1.29 (0.19)	1.13 (0.19)	1.06 (0.17)	1.02 (0.15)	0.81 (0.13)	0.80 (0.15)	0.76 (0.14)	0.77 (0.12)	0.90 (0.12)	1.17 (0.17)
$(La/Sm)_{CN}$	6.16 (1.11)	3.88 (0.75)	2.77 (0.45)	3.04 (0.52)	2.49 (0.42)	2.11 (0.40)	2.10 (0.41)	2.87 (0.46)	2.69 (0.41)	2.76 (0.42)
$(La/Y)_{CN}$	4.73 (0.64)	3.85 (0.59)	3.23 (0.50)	3.50 (0.49)	2.84 (0.44)	2.56 (0.43)	2.82 (0.45)	3.33 (0.48)	2.95 (0.40)	3.38 (0.46)
$Eu_A = Eu/Eu^*$	3.88 (0.18)	3.18 (0.15)	2.35 (0.08)	2.28 (0.09)	2.40 (0.09)	2.67 (0.12)	2.29 (0.11)	2.59 (0.10)	2.98 (0.11)	2.39 (0.09)
$Ce_A = Ce/Ce^*$	1.02 (0.04)	1.04 (0.04)	1.02 (0.04)	1.01 (0.04)	1.00 (0.04)	1.04 (0.04)	0.99 (0.04)	0.98 (0.04)	1.01 (0.04)	1.03 (0.04)

Appendix D: Statistical analysis of the major and trace element compositions of scheelite from blind samples, as determined from LA-ICP-MS.

Table D1. Summary of the major and trace element compositions of scheelite from UK #1 (MPB-13-001).

Sample (ppm)	LOD[1]	Count (above LOD)	Min	Max	Median	Mean
Li	1	0	≤ LOD	≤ LOD	n.d.	n.d.
B	15	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	1554	0	≤ LOD	≤ LOD	n.d.	n.d.
K	25	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	2	1	≤ LOD	3 (3)	3	3 (3)
V	1	2	≤ LOD	≤ LOD	1	1 (0)
Cr	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0.9	53	4 (0.4)	96 (2.3)	11.4	18.1 (0.8)
Fe	2	24	≤ LOD	230.0 (150)	12	26 (23)
Co	0.8	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	2	21	≤ LOD	22 (22)	5	7 (6)
Zn	2	39	≤ LOD	119 (56)	9	23 (16)
As	1	53	7 (1)	87 (43)	19	24 (7)
Rb	0.6	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	0.5	53	48.2 (1.1)	755.0 (16.0)	159.9	212.7 (4.8)
Y	0.5	53	8.4 (0.2)	576.0 (13.0)	91.2	130.3 (2.6)
Nb	1	53	1.6 (0)	531.0 (12)	22	63 (1)
Mo	1	53	2 (0)	714 (13)	85	129 (3)
Ag	0.4	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	1	0	≤ LOD	≤ LOD	n.d.	n.d.
W	1	53	743000 (17000.0)	801000 (18000.0)	770000	771943 (17906)
Th	2	2	≤ LOD	3.7 (0.2)	3	3 (0)
U	2	3	≤ LOD	2.3 (0.1)	2	2 (0)
La	0.2	53	1.8 (0.1)	130.5 (2.4)	29.6	40.5 (0.8)
Ce	1.3	53	6.8 (0.2)	370.3 (6.0)	3.0	90.6 (1.8)
Pr	0.1	53	1.2 (0.04)	53.8 (1.10)	2.0	13.9 (0.3)
Nd	0.5	53	6.30 (0.3)	235.60 (4.7)	0.0	68.4 (1.6)
Sm	0.5	53	1.3 (0.1)	67.1 (1.6)	29.6	18.6 (0.5)
Eu	0.09	53	0.5 (0.0)	27.0 (0.8)	52.60	5.97 (0.17)
Gd	0.2	53	1.4 (0.1)	77.0 (1.5)	10.6	24.1 (0.6)
Tb	0.2	53	≤ LOD	15.3 (0.4)	48.7	3.9 (0.1)
Dy	0.4	53	1.4 (0.1)	113.2 (2.1)	13.9	27.0 (0.7)
Ho	0.2	53	0.3 (0.0)	23.4 (0.4)	4.3	5.4 (0.1)
Er	0.3	53	1.0 (0.1)	69.3 (1.4)	19.0	13.9 (0.3)
Tm	0.3	44	≤ LOD	10.0 (0)	2.5	2.0 (0.1)
Yb	0.3	53	≤ LOD	60 (1)	18.2	8.4 (0.2)
Lu	0.5	27	≤ LOD	7 (0)	4.0	1.7 (0.1)
∑REE + Y		53	46 (1)	1798 (9)	351	454 (3)
$(La/Lu)_{CN}$		53	0.52 (0.15)	16.42 (4.23)	4.89	5.95 (1.65)
$(La/Sm)_{CN}$		53	0.23 (0.06)	7.37 (2.61)	1.42	1.85 (0.48)
$(La/Y)_{CN}$		53	0.36 (0.08)	11.70 (2.76)	2.40	3.00 (0.63)
Eu_A = Eu/Eu*		53	0.18 (0.01)	3.91 (0.20)	0.76	1.23 (0.09)
Ce_A = Ce/Ce*		53	0.28 (0.01)	1.15 (0.06)	0.90	0.84 (0.04)

[1]LOD-Limit of detection was calculated from repeated measurements of NIST 612.
n.d. = not determined

Table D2. Summary of the major and trace element compositions of scheelite from UK #2 (MPB-13-002).

Sample (ppm)	LOD[1]	Count (above LOD)	Min	Max	Median	Mean
Li	1	1	≤ LOD	1 (0)	1	1 (0)
B	15	1	≤ LOD	19 (3)	19	19 (3)
Na	1554	0	≤ LOD	≤ LOD	n.d.	n.d.
K	25	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	2	1	≤ LOD	2 (1)	2	2 (1)
V	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0.9	75	7 (0.5)	34 (4.2)	21.0	21.1 (0.9)
Fe	2	22	≤ LOD	210.0 (110)	14	32 (21)
Co	0.8	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	1	2	≤ LOD	2.8 (3)	2	2 (2)
Cu	2	15	≤ LOD	40 (30)	4	9 (8)
Zn	2	53	≤ LOD	52 (58)	6	9 (8)
As	1	75	6 (0)	50 (28)	11	13 (4)
Rb	0.6	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	0.5	75	48.4 (1.1)	69.8 (1.8)	58.8	58.5 (1.3)
Y	0.5	75	163.0 (2.9)	2480.0 (160.0)	841.0	946.0 (33.5)
Nb	1	75	51.1 (1)	567.2 (8)	188	239 (5)
Mo	1	75	8 (0)	19 (1)	12	12 (0)
Ag	0.4	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	1	0	≤ LOD	≤ LOD	n.d.	n.d.
W	1	75	723000 (12000.0)	808000 (20000.0)	772000	768947 (17480)
Th	2	1	≤ LOD	2.4 (0.1)	2	2 (0)
U	2	1	≤ LOD	2.8 (0.2)	3	3 (0)
La	0.2	75	3.3 (0.1)	43.9 (7.4)	9.0	10.9 (0.4)
Ce	1.3	75	22.1 (0.5)	116.0 (13.0)	2.4	54.0 (1.5)
Pr	0.1	75	5.7 (0.15)	23.3 (1.70)	2.8	14.3 (0.4)
Nd	0.5	75	38.33 (0.8)	194.30 (6.0)	0.0	103.9 (3.0)
Sm	0.5	75	14.4 (0.5)	143.0 (5.6)	9.0	56.3 (1.8)
Eu	0.09	75	6.5 (0.2)	59.4 (1.9)	48.80	19.96 (0.55)
Gd	0.2	75	20.1 (0.7)	239.4 (8.5)	14.0	99.0 (3.1)
Tb	0.2	75	3.2 (0.1)	49.1 (1.9)	103.0	20.4 (0.7)
Dy	0.4	75	23.4 (0.5)	401.0 (41.0)	50.7	163.8 (5.4)
Ho	0.2	75	5.7 (0.2)	88.8 (9.4)	16.4	37.6 (1.3)
Er	0.3	75	18.8 (0.5)	288.0 (17.0)	87.1	118.1 (4.1)
Tm	0.3	75	2.5 (0)	49.6 (3)	17.1	17.0 (0.7)
Yb	0.3	75	15 (0)	355 (29)	138.0	104.3 (4.7)
Lu	0.5	75	2 (0)	50 (4)	33.7	15.1 (0.7)
∑REE + Y		75	374 (2)	4274 (38)	1692	1780 (10)
$(La/Lu)_{CN}$		26	n.d.	0.30 (0.10)	n.d.	0.17 (0.06)
$(La/Sm)_{CN}$		49	n.d.	0.42 (0.14)	0.13	0.20 (0.07)
$(La/Y)_{CN}$		32	n.d.	0.34 (0.11)	n.d.	0.16 (0.05)
Eu_A = Eu/Eu*		75	0.23 (0.02)	3.65 (0.27)	0.77	0.97 (0.06)
Ce_A = Ce/Ce*		75	0.66 (0.05)	0.99 (0.05)	0.88	0.87 (0.06)

[1]LOD-Limit of detection was calculated from repeated measurements of NIST 612.
n.d. = not determined

Table D3. Summary of the major and trace element compositions of scheelite from UK #3 (MPB-13-003).

Sample (ppm)	LOD[1]	Count (above LOD)	Min	Max	Median	Mean
Li	1	1	≤ LOD	2 (1)	2	2 (1)
B	15	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	1554	0	≤ LOD	≤ LOD	n.d.	n.d.
K	25	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	2	0	≤ LOD	≤ LOD	n.d.	n.d.
V	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0.9	60	11 (0.4)	19 (2.3)	15.4	15.3 (0.7)
Fe	2	20	≤ LOD	340.0 (280)	20	70 (62)
Co	0.8	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	1	3	≤ LOD	5.2 (5)	2	3 (3)
Cu	2	18	≤ LOD	90 (160)	5	13 (17)
Zn	2	43	≤ LOD	210 (340)	7	28 (42)
As	1	60	14 (1)	200 (350)	21	26 (10)
Rb	0.6	1	≤ LOD	≤ LOD	n.d.	0.8 (0.2)
Sr	0.5	60	183.4 (3.2)	276.7 (5.1)	211.2	216.5 (4.0)
Y	0.5	60	65.8 (1.7)	127.5 (2.0)	93.9	94.6 (1.7)
Nb	1	60	64.2 (2)	200.0 (4)	129	126 (2)
Mo	1	60	1349 (27)	3077 (55)	2,463	2491 (45)
Ag	0.4	1	≤ LOD	≤ LOD	n.d.	1.1 (0.9)
Sn	1	0	≤ LOD	≤ LOD	n.d.	n.d.
W	1	60	740000 (15000.0)	775000 (17000.0)	755000	756400 (15417)
Th	2	0	≤ LOD	≤ LOD	n.d.	n.d.
U	2	0	≤ LOD	≤ LOD	n.d.	n.d.
La	0.2	60	1.5 (0.1)	17.9 (0.3)	8.1	8.6 (0.2)
Ce	1.3	60	7.5 (0.3)	57.3 (1.0)	n.d.	31.5 (0.7)
Pr	0.1	60	1.6 (0.08)	8.5 (0.16)	n.d.	5.5 (0.1)
Nd	0.5	60	11.59 (0.4)	49.10 (1.2)	0.0	31.8 (0.8)
Sm	0.5	60	4.4 (0.2)	16.8 (0.4)	8.1	10.2 (0.4)
Eu	0.09	60	1.7 (0.1)	5.0 (0.2)	31.07	3.31 (0.10)
Gd	0.2	60	5.7 (0.3)	24.5 (0.6)	5.5	13.6 (0.4)
Tb	0.2	60	1.1 (0.0)	3.7 (0.1)	32.4	2.2 (0.1)
Dy	0.4	60	7.8 (0.3)	26.3 (0.5)	10.6	16.0 (0.4)
Ho	0.2	60	2.0 (0.1)	5.6 (0.1)	3.3	3.7 (0.1)
Er	0.3	60	7.3 (0.2)	16.1 (0.4)	13.4	11.5 (0.3)
Tm	0.3	60	1.2 (0)	2.3 (0)	2.2	1.6 (0.1)
Yb	0.3	60	7 (0)	15 (0)	15.9	9.6 (0.3)
Lu	0.5	60	≤ LOD	2 (0)	3.7	1.3 (0.0)
∑REE + Y		60	164 (1)	320 (2)	254	245 (1)
$(La/Lu)_{CN}$		60	0.11 (0.03)	1.70 (0.38)	0.63	0.68 (0.17)
$(La/Sm)_{CN}$		60	0.15 (0.04)	1.39 (0.34)	0.47	0.56 (0.14)
$(La/Y)_{CN}$		60	0.11 (0.03)	1.67 (0.30)	0.57	0.62 (0.12)
$Eu_A = Eu/Eu^*$		60	0.74 (0.04)	1.03 (0.08)	0.86	0.86 (0.06)
$Ce_A = Ce/Ce^*$		60	0.99 (0.07)	1.13 (0.06)	1.06	1.06 (0.06)

[1]LOD-Limit of detection was calculated from repeated measurements of NIST 612.

n.d. = not determined

Table D4. Summary of the major and trace element compositions of scheelite from UK #4 (MPB-13-006).

Sample (ppm)	LOD[1]	Count (above LOD)	Min	Max	Median	Mean
Li	1	0	≤ LOD	≤ LOD	n.d.	n.d.
B	15	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	1554	1	≤ LOD	1600 (860)	1,600	1600 (860)
K	25	0	≤ LOD	≤ LOD	n.d.	n.d.
Ti	2	5	≤ LOD	4 (3)	3	3 (3)
V	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0.9	75	8 (0.3)	35 (6.2)	17.6	17.4 (1.0)
Fe	2	27	≤ LOD	790.0 (650)	90	189 (162)
Co	0.8	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	1	6	≤ LOD	4.5 (5)	2	2 (3)
Cu	2	30	≤ LOD	110 (200)	5	15 (17)
Zn	2	45	≤ LOD	1300 (1500)	6	82 (93)
As	1	75	23 (2)	950 (700)	56	98 (41)
Rb	0.6	0	≤ LOD	≤ LOD	n.d.	n.d.
Sr	0.5	75	54.7 (1.3)	90.7 (2.0)	65.5	68.0 (1.4)
Y	0.5	75	33.4 (0.8)	455.3 (8.1)	178.7	193.2 (3.9)
Nb	1	75	20.4 (1)	221.1 (4)	57	79 (2)
Mo	1	75	140 (3)	727 (17)	561	551 (11)
Ag	0.4	7	≤ LOD	18 (4.4)	n.d.	3.4 (1.2)
Sn	1	0	≤ LOD	≤ LOD	n.d.	n.d.
W	1	75	698000 (19000.0)	750000 (13000.0)	723000	722744 (15025)
Th	2	0	≤ LOD	≤ LOD	n.d.	n.d.
U	2	0	≤ LOD	≤ LOD	n.d.	n.d.
La	0.2	75	1.2 (0.0)	26.4 (0.6)	6.1	8.3 (0.2)
Ce	1.3	75	6.4 (0.2)	91.9 (2.1)	n.d.	35.8 (0.9)
Pr	0.1	75	2.2 (0.06)	16.4 (0.37)	n.d.	7.6 (0.2)
Nd	0.5	75	14.71 (0.9)	105.60 (2.4)	0.0	54.7 (1.3)
Sm	0.5	75	5.0 (0.3)	48.9 (1.3)	6.1	26.4 (0.7)
Eu	0.09	75	0.7 (0.0)	5.5 (0.1)	34.70	3.03 (0.10)
Gd	0.2	75	7.8 (0.4)	84.9 (2.2)	7.8	48.8 (1.2)
Tb	0.2	75	1.2 (0.1)	15.4 (0.3)	54.9	7.8 (0.2)
Dy	0.4	75	7.8 (0.3)	120.3 (2.7)	25.9	49.6 (1.2)
Ho	0.2	75	1.5 (0.1)	25.0 (0.5)	3.1	9.5 (0.2)
Er	0.3	75	3.5 (0.2)	55.8 (1.0)	49.4	21.4 (0.5)
Tm	0.3	75	≤ LOD	4.9 (0)	7.7	2.1 (0.1)
Yb	0.3	75	2 (0)	21 (1)	46.7	9.0 (0.3)
Lu	0.5	68	≤ LOD	2 (0)	8.7	1.1 (0.0)
∑REE + Y		75	101 (1)	858 (3)	486	478 (3)
$(La/Lu)_{CN}$		72	n.d.	2.24 (0.82)	0.73	0.90 (0.24)
$(La/Sm)_{CN}$		53	n.d.	0.61 (0.19)	n.d.	0.25 (0.06)
$(La/Y)_{CN}$		69	n.d.	0.97 (0.24)	0.27	0.34 (0.07)
$Eu_A = Eu/Eu^*$		75	0.18 (0.01)	0.40 (0.03)	0.25	0.26 (0.02)
$Ce_A = Ce/Ce^*$		75	0.70 (0.05)	1.08 (0.06)	0.98	0.96 (0.06)

[1]LOD-Limit of detection was calculated from repeated measurements of NIST 612.
n.d. = not determined

Table D5. Summary of the major and trace element compositions of scheelite from UK #5 (MWS).

Sample (ppm)	LOD[1]	Count (above LOD)	Min	Max	Median	Mean
Li	1	3	≤ LOD	2 (1)	2	2 (1)
B	15	0	≤ LOD	≤ LOD	n.d.	n.d.
Na	1554	0	≤ LOD	≤ LOD	n.d.	n.d.
K	25	3	≤ LOD	415 (45)	115	213 (30)
Ti	2	4	≤ LOD	17 (11)	8	9 (4)
V	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cr	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Mn	0.9	13	≤ LOD	5 (0.4)	2.6	2.9 (0.6)
Fe	2	13	≤ LOD	259.0 (82)	20	53 (41)
Co	0.8	0	≤ LOD	≤ LOD	n.d.	n.d.
Ni	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Cu	2	3	≤ LOD	3 (4)	3	3 (4)
Zn	2	24	≤ LOD	21 (34)	4	6 (8)
As	1	49	6 (0)	37 (7)	8	9 (2)
Rb	0.6	3	≤ LOD	2 (0.3)	n.d.	1.3 (0.2)
Sr	0.5	49	2212.0 (52.0)	9590.0 (260.0)	5,430.0	5682.6 (134.7)
Y	0.5	49	24.6 (1.0)	703.0 (40.0)	118.4	151.8 (6.2)
Nb	1	4	0.9 (0)	1.5 (0)	1	1 (0)
Mo	1	0	≤ LOD	≤ LOD	n.d.	n.d.
Ag	0.4	0	≤ LOD	≤ LOD	n.d.	n.d.
Sn	1	0	≤ LOD	≤ LOD	n.d.	n.d.
W	1	49	676000 (14000.0)	731000 (18000.0)	709000	708959 (15306)
Th	2	2	0.2 (0.0)	2.8 (0.3)	3	3 (0)
U	2	18	≤ LOD	3.0 (0.1)	2	2 (0)
La	0.2	49	6.4 (0.2)	70.7 (4.2)	18.0	20.0 (0.6)
Ce	1.3	49	8.9 (0.3)	252.0 (14.0)	2.5	46.1 (1.9)
Pr	0.1	49	0.5 (0.04)	32.7 (1.60)	2.1	6.1 (0.3)
Nd	0.5	49	1.04 (0.2)	131.90 (3.7)	0.0	28.3 (1.6)
Sm	0.5	48	0.2 (0.1)	56.2 (1.9)	18.0	10.0 (0.7)
Eu	0.09	49	0.3 (0.0)	33.3 (0.8)	35.32	5.92 (0.33)
Gd	0.2	49	≤ LOD	77.0 (2.4)	4.1	14.5 (0.9)
Tb	0.2	48	≤ LOD	14.5 (0.5)	16.7	2.9 (0.2)
Dy	0.4	49	0.7 (0.1)	96.3 (3.0)	5.7	21.3 (1.2)
Ho	0.2	48	≤ LOD	17.5 (0.8)	3.7	4.4 (0.2)
Er	0.3	49	1.2 (0.1)	56.7 (2.4)	8.5	12.8 (0.6)
Tm	0.3	48	≤ LOD	8.9 (0)	1.7	2.0 (0.1)
Yb	0.3	49	3 (0)	53 (3)	13.6	12.6 (0.5)
Lu	0.5	46	≤ LOD	5 (0)	2.8	1.5 (0.1)
∑REE + Y		49	61 (1)	1513 (16)	265	340 (3)
$(La/Lu)_{CN}$		49	0.78 (0.19)	2.75 (0.73)	1.42	1.51 (0.43)
$(La/Sm)_{CN}$		49	0.17 (0.04)	54.10 (31.03)	2.14	3.77 (1.55)
$(La/Y)_{CN}$		49	0.24 (0.05)	3.72 (0.87)	1.00	1.14 (0.30)
$Eu_A = Eu/Eu^*$		49	0.80 (0.05)	3.99 (1.73)	1.68	1.78 (0.27)
$Ce_A = Ce/Ce^*$		49	0.47 (0.03)	1.25 (0.13)	0.92	0.93 (0.08)

[1]LOD-Limit of detection was calculated from repeated measurements of NIST 612.
n.d. = not determined

Appendix E: Major and trace element compositions of scheelite from blind samples, as determined from LA-ICP-MS.

TABLE E1. Major and trace element compositions of scheelite from UK #1 (MPB-13-001).

Sample (ppm)	UK#1_1	UK#1_2	UK#1_3	UK#1_4	UK#1_5	UK#1_6	UK#1_7	UK#1_8	UK#1_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	7.8 (0.5)	9.7 (0.4)	10.0 (0.4)	18.6 (0.5)	22.1 (0.8)	29.5 (0.9)	10.9 (0.6)	6.6 (0.3)	18.7 (0.6)
Fe	88 (82)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (22)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	3 (3)	≤ LOD	≤ LOD	5 (7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	19 (14)	3 (3)	≤ LOD	6 (5)	≤ LOD	3 (4)	9 (10)	≤ LOD	2 (1)
As	21 (9)	9 (1)	8 (1)	21 (13)	9 (0)	11 (1)	19 (9)	14 (4)	12 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	243.5 (5.0)	238.3 (5.6)	234.7 (5.8)	181.4 (4.2)	183.7 (4.8)	190.1 (4.6)	159.7 (3.8)	162.1 (3.5)	162.2 (4.0)
Y	10.4 (0.3)	16.5 (0.4)	17.1 (0.5)	140.6 (2.9)	135.0 (3.3)	148.1 (4.1)	91.2 (2.4)	95.4 (2.1)	89.3 (2.0)
Nb	2 (0)	2 (0)	2 (0)	465 (9)	478 (10)	531 (12)	96 (2)	102 (2)	98 (2)
Mo	85 (2)	85 (2)	86 (2)	167 (3)	169 (4)	200 (5)	111 (3)	106 (2)	108 (2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	746000 (21000)	762000 (21000)	775000 (19000)	763000 (14000)	763000 (23000)	761000 (17000)	764000 (18000)	763000 (17000)	770000 (19000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)	4 (0)	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	2 (0)	2 (0)	2 (0)	≤ LOD	≤ LOD	≤ LOD
La	7.2 (0.2)	7.2 (0.2)	5.6 (0.2)	102.7 (1.6)	107.1 (2.1)	117.2 (2.4)	33.2 (0.8)	29.6 (0.5)	32.3 (0.7)
Ce	10.8 (0.3)	11.4 (0.3)	9.4 (0.3)	261.3 (4.8)	270.4 (6.8)	295.0 (5.6)	58.3 (1.3)	54.3 (1.0)	57.0 (1.2)
Pr	1.3 (0.0)	1.5 (0.0)	1.3 (0.0)	31.3 (0.6)	32.0 (1.0)	34.2 (0.7)	13.8 (0.3)	13.7 (0.3)	13.9 (0.3)
Nd	7.1 (0.3)	9.5 (0.3)	8.7 (0.3)	148.4 (2.9)	148.6 (4.4)	160.3 (3.2)	69.1 (1.8)	70.5 (1.3)	69.8 (1.8)
Sm	1.4 (0.1)	1.8 (0.1)	2.0 (0.2)	28.8 (0.8)	27.2 (0.8)	30.2 (0.7)	15.8 (0.5)	16.5 (0.6)	16.2 (0.6)
Eu	0.70 (0.03)	0.94 (0.05)	1.07 (0.06)	5.12 (0.15)	5.15 (0.16)	6.03 (0.22)	5.13 (0.17)	4.99 (0.16)	5.09 (0.17)
Gd	2.2 (0.2)	3.1 (0.2)	3.2 (0.2)	30.6 (0.8)	29.4 (1.0)	31.9 (0.8)	19.7 (0.6)	20.9 (0.7)	20.3 (0.6)
Tb	0.3 (0.0)	0.4 (0.0)	0.4 (0.0)	3.8 (0.1)	3.7 (0.1)	4.1 (0.1)	3.0 (0.1)	3.1 (0.1)	2.9 (0.1)
Dy	1.9 (0.1)	2.8 (0.1)	2.8 (0.1)	22.8 (0.5)	22.3 (0.7)	24.9 (0.7)	19.6 (0.7)	20.0 (0.5)	19.1 (0.5)
Ho	0.5 (0.0)	0.7 (0.0)	0.7 (0.0)	4.7 (0.1)	4.6 (0.1)	5.1 (0.2)	4.0 (0.1)	4.2 (0.1)	3.9 (0.1)
Er	1.4 (0.1)	2.1 (0.1)	2.3 (0.1)	12.8 (0.3)	11.8 (0.4)	13.5 (0.3)	10.1 (0.3)	10.7 (0.3)	9.7 (0.3)
Tm	≤ LOD	≤ LOD	≤ LOD	1.5 (0.0)	1.4 (0.0)	1.5 (0.1)	1.1 (0.1)	1.2 (0.0)	1.1 (0.0)
Yb	0.8 (0.1)	1.3 (0.1)	1.4 (0.1)	6.9 (0.3)	6.6 (0.2)	7.0 (0.3)	5.9 (0.2)	6.3 (0.2)	5.7 (0.2)
Lu	≤ LOD	≤ LOD	≤ LOD	0.8 (0.0)	0.8 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
∑REE + Y	46 (1)	60 (1)	56 (1)	802 (6)	806 (9)	880 (7)	351 (3)	352 (2)	347 (3)
$(La/Lu)_{CN}$	4.89 (1.57)	3.42 (1.14)	2.56 (0.84)	14.03 (3.37)	14.57 (3.81)	16.42 (4.23)	4.94 (1.38)	4.11 (1.04)	5.01 (1.29)
$(La/Sm)_{CN}$	3.23 (1.04)	2.45 (0.76)	1.76 (0.56)	2.24 (0.46)	2.47 (0.54)	2.43 (0.51)	1.32 (0.31)	1.13 (0.26)	1.25 (0.29)
$(La/Y)_{CN}$	4.61 (1.03)	2.88 (0.65)	2.17 (0.50)	4.86 (0.92)	5.27 (1.11)	5.26 (1.15)	2.42 (0.54)	2.06 (0.41)	2.40 (0.50)
Eu_A = Eu/Eu*	1.20 (0.14)	1.18 (0.12)	1.29 (0.14)	0.52 (0.03)	0.55 (0.03)	0.59 (0.03)	0.88 (0.05)	0.81 (0.05)	0.85 (0.05)
Ce_A = Ce/Ce*	0.80 (0.05)	0.80 (0.05)	0.82 (0.05)	1.10 (0.05)	1.10 (0.06)	1.11 (0.05)	0.65 (0.04)	0.64 (0.03)	0.64 (0.03)

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TABLE E1. *(continued)*

Sample (ppm)	UK#1_10	UK#1_11	UK#1_12	UK#1_13	UK#1_14	UK#1_15	UK#1_16	UK#1_17	UK#1_18
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	8.1 (0.4)	14.3 (0.5)	19.1 (0.8)	6.8 (0.7)	5.8 (0.4)	5.7 (0.4)	6.2 (0.5)	5.5 (0.4)	5.3 (0.3)
Fe	14 (23)	≤ LOD	12 (7)	6 (11)	≤ LOD	≤ LOD	34 (36)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	4 (5)	≤ LOD	22 (22)	≤ LOD	≤ LOD	13 (9)	≤ LOD	≤ LOD
Zn	111 (64)	5 (4)	≤ LOD	9 (7)	≤ LOD	5 (5)	46 (32)	≤ LOD	2 (2)
As	30 (11)	11 (3)	10 (2)	21 (8)	14 (2)	12 (1)	87 (43)	17 (6)	12 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	128.2 (2.9)	125.9 (2.3)	127.1 (3.5)	105.2 (2.2)	107.6 (2.0)	107.7 (2.4)	219.5 (4.5)	224.1 (4.5)	218.5 (5.0)
Y	82.3 (1.6)	81.3 (1.7)	77.6 (2.0)	119.8 (2.4)	132.4 (2.4)	135.3 (2.7)	72.0 (1.3)	80.0 (1.4)	75.8 (1.6)
Nb	8 (0)	8 (0)	8 (0)	9 (0)	9 (0)	9 (0)	46 (1)	48 (1)	46 (1)
Mo	5 (0)	5 (0)	4 (0)	2 (0)	2 (0)	2 (0)	697 (14)	714 (13)	684 (16)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	751000 (17000)	768000 (19000)	777000 (17000)	783000 (20000)	786000 (20000)	769000 (19000)	770000 (19000)	794000 (16000)	771000 (18000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	32.6 (0.5)	33.1 (0.6)	34.6 (0.8)	12.2 (0.2)	13.5 (0.3)	12.9 (0.3)	16.7 (0.3)	14.5 (0.3)	15.4 (0.4)
Ce	77.0 (1.6)	78.1 (1.5)	80.3 (1.8)	53.4 (0.9)	57.5 (1.3)	57.1 (1.0)	13.6 (0.3)	12.1 (0.3)	12.6 (0.3)
Pr	11.4 (0.2)	11.5 (0.3)	11.9 (0.3)	11.6 (0.2)	12.5 (0.2)	12.4 (0.3)	4.3 (0.1)	4.1 (0.1)	4.2 (0.1)
Nd	62.3 (1.5)	62.3 (1.5)	64.4 (1.7)	77.5 (1.6)	84.2 (1.8)	86.2 (2.3)	32.8 (1.0)	35.2 (0.9)	34.7 (0.9)
Sm	18.7 (0.6)	18.0 (0.5)	18.4 (0.6)	26.2 (0.6)	28.0 (0.8)	29.2 (0.9)	8.8 (0.3)	10.2 (0.3)	9.6 (0.3)
Eu	3.57 (0.12)	3.61 (0.11)	3.65 (0.12)	4.80 (0.13)	4.89 (0.12)	4.99 (0.14)	2.10 (0.09)	2.09 (0.09)	2.04 (0.07)
Gd	24.9 (0.6)	25.3 (0.7)	24.0 (0.7)	34.9 (0.9)	37.2 (0.8)	37.9 (1.1)	16.3 (0.5)	18.0 (0.6)	17.0 (0.6)
Tb	3.8 (0.1)	3.8 (0.1)	3.7 (0.1)	5.2 (0.1)	5.6 (0.1)	5.8 (0.1)	2.0 (0.1)	2.2 (0.1)	2.2 (0.1)
Dy	24.3 (0.6)	23.8 (0.6)	22.5 (0.5)	33.9 (0.8)	36.3 (0.8)	37.8 (1.0)	13.1 (0.4)	14.7 (0.4)	13.9 (0.4)
Ho	4.3 (0.1)	4.2 (0.1)	4.0 (0.1)	6.3 (0.2)	6.9 (0.1)	7.1 (0.1)	3.0 (0.1)	3.3 (0.1)	3.1 (0.1)
Er	9.3 (0.3)	9.3 (0.2)	8.9 (0.2)	15.5 (0.4)	17.2 (0.4)	17.4 (0.5)	7.6 (0.2)	8.7 (0.3)	8.1 (0.2)
Tm	0.8 (0.0)	0.9 (0.0)	0.9 (0.0)	1.6 (0.1)	1.8 (0.1)	1.9 (0.1)	0.7 (0.0)	0.8 (0.0)	0.8 (0.0)
Yb	3.7 (0.2)	3.3 (0.2)	3.4 (0.2)	7.3 (0.3)	8.6 (0.3)	8.8 (0.3)	3.1 (0.2)	3.3 (0.2)	3.3 (0.1)
Lu	≤ LOD	≤ LOD	≤ LOD	0.9 (0.0)	1.1 (0.0)	1.1 (0.0)	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	359 (3)	359 (2)	359 (3)	411 (2)	448 (3)	456 (3)	196 (1)	210 (1)	203 (1)
$(La/Lu)_{CN}$	7.53 (1.96)	8.36 (2.42)	8.92 (2.79)	1.38 (0.36)	1.33 (0.33)	1.22 (0.30)	4.37 (1.18)	3.50 (0.91)	3.70 (1.14)
$(La/Sm)_{CN}$	1.09 (0.23)	1.15 (0.25)	1.18 (0.28)	0.29 (0.06)	0.30 (0.07)	0.28 (0.06)	1.18 (0.27)	0.89 (0.21)	1.01 (0.25)
$(La/Y)_{CN}$	2.63 (0.50)	2.71 (0.53)	2.97 (0.65)	0.68 (0.13)	0.68 (0.14)	0.63 (0.13)	1.54 (0.29)	1.20 (0.24)	1.35 (0.29)
$Eu_A = Eu/Eu^*$	0.50 (0.03)	0.51 (0.03)	0.53 (0.03)	0.48 (0.02)	0.46 (0.02)	0.46 (0.03)	0.53 (0.04)	0.46 (0.03)	0.48 (0.03)
$Ce_A = Ce/Ce^*$	0.96 (0.05)	0.96 (0.05)	0.95 (0.05)	0.98 (0.05)	0.96 (0.05)	0.98 (0.06)	0.38 (0.02)	0.37 (0.02)	0.37 (0.02)

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TABLE E1. *(continued)*

Sample (ppm)	UK#1_19	UK#1_20	UK#1_21	UK#1_22	UK#1_23	UK#1_24	UK#1_25	UK#1_26	UK#1_27
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	11.4 (0.4)	16.5 (3.9)	12.8 (0.5)	10.5 (0.7)	16.0 (1.5)	17.9 (2.0)	32.9 (0.8)	44.1 (1.3)	43.5 (1.0)
Fe	31 (30)	17 (7)	7 (8)	11 (10)	11 (12)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	4 (3)	≤ LOD	≤ LOD	3 (3)	3 (5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	69 (44)	4 (3)	2 (2)	21 (15)	7 (6)	2 (2)	8 (7)	10 (7)	8 (10)
As	67 (15)	67 (16)	69 (9)	30 (10)	65 (3)	22 (4)	22 (2)	29 (8)	24 (3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	245.5 (4.8)	249.8 (5.3)	243.9 (4.5)	50.9 (0.8)	63.6 (1.1)	72.4 (1.4)	135.5 (2.5)	138.5 (2.8)	135.2 (2.0)
Y	188.3 (3.6)	173.4 (3.6)	200.2 (3.4)	28.5 (0.5)	140.5 (2.3)	40.8 (0.8)	435.0 (10.0)	431.6 (7.9)	426.9 (8.1)
Nb	58 (1)	52 (1)	58 (1)	23 (0)	128 (2)	22 (0)	117 (3)	107 (2)	114 (2)
Mo	28 (1)	24 (1)	20 (1)	202 (5)	547 (10)	355 (8)	28 (1)	28 (1)	25 (1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	784000 (16000)	776000 (16000)	775000 (15000)	771000 (15000)	798000 (18000)	788000 (15000)	800000 (13000)	798000 (18000)	789000 (15000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	42.2 (0.8)	44.4 (0.9)	43.0 (0.7)	1.8 (0.1)	8.7 (0.2)	2.2 (0.1)	114.4 (2.2)	130.5 (2.4)	122.0 (2.0)
Ce	75.0 (1.4)	79.5 (1.5)	75.0 (1.2)	6.8 (0.2)	35.6 (0.7)	9.0 (0.2)	308.2 (6.3)	328.1 (6.5)	311.4 (5.0)
Pr	9.0 (0.2)	9.5 (0.2)	8.8 (0.2)	1.3 (0.0)	7.1 (0.2)	1.9 (0.0)	42.4 (0.9)	43.7 (0.8)	42.2 (0.8)
Nd	43.4 (0.9)	46.4 (1.0)	44.1 (0.9)	9.3 (0.3)	47.9 (1.0)	13.1 (0.4)	197.4 (3.7)	199.3 (4.0)	194.5 (3.3)
Sm	16.9 (0.5)	16.7 (0.5)	17.0 (0.5)	4.3 (0.2)	22.1 (0.7)	6.0 (0.2)	59.5 (1.1)	57.5 (1.1)	56.9 (1.0)
Eu	16.56 (0.42)	14.93 (0.38)	17.64 (0.38)	0.90 (0.04)	2.38 (0.08)	1.03 (0.06)	3.78 (0.13)	4.26 (0.13)	4.03 (0.10)
Gd	32.1 (0.6)	31.2 (0.9)	33.1 (0.8)	7.3 (0.3)	38.5 (0.9)	9.9 (0.3)	71.6 (1.3)	67.4 (1.4)	68.3 (1.2)
Tb	6.2 (0.1)	5.9 (0.1)	6.5 (0.2)	1.1 (0.0)	6.1 (0.2)	1.5 (0.1)	12.5 (0.3)	12.0 (0.3)	12.1 (0.2)
Dy	46.3 (1.0)	44.0 (0.9)	49.4 (1.0)	7.2 (0.3)	37.8 (0.8)	9.8 (0.3)	87.4 (2.0)	86.5 (1.8)	85.1 (1.5)
Ho	9.0 (0.2)	8.6 (0.2)	9.8 (0.2)	1.4 (0.0)	7.0 (0.1)	1.9 (0.1)	16.3 (0.4)	16.1 (0.3)	15.9 (0.3)
Er	19.9 (0.3)	18.8 (0.4)	21.8 (0.4)	3.4 (0.1)	15.8 (0.4)	4.8 (0.2)	38.9 (0.8)	38.4 (0.8)	38.5 (0.7)
Tm	1.8 (0.0)	1.7 (0.0)	1.9 (0.1)	0.4 (0.0)	1.5 (0.1)	0.6 (0.0)	4.5 (0.1)	4.5 (0.1)	4.4 (0.1)
Yb	6.1 (0.2)	5.8 (0.2)	6.8 (0.2)	1.9 (0.1)	7.3 (0.3)	3.2 (0.1)	21.5 (0.6)	21.3 (0.5)	21.3 (0.6)
Lu	≤ LOD	0.5 (0.0)	0.6 (0.0)	≤ LOD	0.9 (0.0)	≤ LOD	2.2 (0.1)	2.2 (0.1)	2.2 (0.1)
∑REE + Y	513 (2)	501 (3)	536 (2)	76 (1)	379 (2)	106 (1)	1415 (8)	1443 (8)	1406 (7)
$(La/Lu)_{CN}$	9.13 (2.55)	9.12 (2.34)	7.41 (1.87)	0.82 (0.28)	0.97 (0.23)	0.52 (0.15)	5.39 (1.17)	6.10 (1.36)	5.88 (1.22)
$(La/Sm)_{CN}$	1.56 (0.34)	1.66 (0.37)	1.59 (0.34)	0.26 (0.07)	0.25 (0.06)	0.23 (0.06)	1.21 (0.23)	1.42 (0.28)	1.34 (0.25)
$(La/Y)_{CN}$	1.49 (0.29)	1.70 (0.34)	1.43 (0.26)	0.42 (0.10)	0.41 (0.08)	0.36 (0.08)	1.75 (0.36)	2.01 (0.38)	1.90 (0.36)
$Eu_A = Eu/Eu^*$	2.13 (0.10)	1.96 (0.11)	2.22 (0.11)	0.49 (0.04)	0.25 (0.01)	0.40 (0.03)	0.18 (0.01)	0.21 (0.01)	0.20 (0.01)
$Ce_A = Ce/Ce^*$	0.89 (0.04)	0.89 (0.05)	0.88 (0.04)	1.00 (0.07)	1.02 (0.06)	0.98 (0.06)	1.06 (0.05)	1.04 (0.05)	1.04 (0.05)

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TABLE E1. *(continued)*

Sample (ppm)	UK#1_28	UK#1_29	UK#1_30	UK#1_31	UK#1_32	UK#1_33	UK#1_34	UK#1_35	UK#1_36
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	95.9 (2.3)	88.9 (3.3)	87.2 (2.9)	15.0 (0.6)	12.6 (0.5)	10.9 (0.4)	8.5 (0.4)	8.3 (0.4)	10.4 (0.5)
Fe	12 (9)	3 (6)	≤ LOD	8 (8)	≤ LOD	≤ LOD	6 (9)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	3 (3)	≤ LOD	≤ LOD	3 (3)	≤ LOD	≤ LOD	4 (4)	≤ LOD	≤ LOD
Zn	39 (26)	11 (10)	≤ LOD	6 (8)	≤ LOD	≤ LOD	25 (27)	22 (30)	≤ LOD
As	21 (10)	11 (3)	12 (4)	27 (17)	7 (1)	8 (2)	23 (10)	7 (2)	7 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	159.9 (2.8)	168.0 (3.4)	158.4 (4.3)	130.7 (2.7)	137.6 (3.3)	136.7 (2.9)	115.2 (3.3)	117.1 (3.1)	119.0 (3.1)
Y	575.0 (10.0)	562.0 (9.8)	576.0 (13.0)	41.6 (0.7)	42.0 (0.9)	40.2 (0.9)	8.5 (0.3)	8.4 (0.2)	8.6 (0.3)
Nb	32 (1)	32 (1)	31 (1)	131 (3)	143 (3)	129 (2)	2 (0)	2 (0)	2 (0)
Mo	9 (0)	8 (0)	9 (0)	249 (5)	245 (5)	245 (5)	154 (4)	154 (3)	163 (4)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	788000 (19000)	790000 (19000)	784000 (19000)	764000 (18000)	765000 (18000)	783000 (15000)	771000 (17000)	773000 (19000)	755000 (21000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	116.5 (1.9)	113.8 (2.2)	113.3 (1.9)	31.3 (0.5)	39.3 (0.8)	33.7 (0.8)	12.5 (0.3)	13.6 (0.3)	15.1 (0.4)
Ce	370.3 (6.0)	365.6 (7.5)	370.2 (6.5)	87.7 (1.7)	106.1 (2.3)	95.1 (2.2)	18.5 (0.5)	19.2 (0.4)	20.2 (0.4)
Pr	53.8 (1.1)	51.9 (1.1)	53.1 (1.2)	10.9 (0.2)	12.5 (0.3)	11.6 (0.3)	1.8 (0.1)	1.8 (0.1)	1.9 (0.1)
Nd	235.6 (4.7)	226.9 (5.3)	232.8 (6.4)	52.2 (1.1)	57.4 (1.7)	53.9 (1.5)	7.2 (0.3)	7.0 (0.3)	6.7 (0.3)
Sm	67.1 (1.6)	65.2 (1.7)	66.6 (1.8)	11.2 (0.3)	11.6 (0.4)	10.7 (0.4)	1.4 (0.1)	1.4 (0.1)	1.3 (0.1)
Eu	4.31 (0.11)	4.25 (0.15)	4.23 (0.13)	2.59 (0.10)	2.30 (0.09)	2.42 (0.09)	1.33 (0.05)	1.53 (0.07)	1.65 (0.07)
Gd	77.0 (1.5)	75.8 (1.7)	75.0 (1.8)	12.4 (0.4)	12.9 (0.5)	12.1 (0.4)	1.7 (0.1)	1.4 (0.1)	1.5 (0.1)
Tb	15.3 (0.4)	14.7 (0.4)	15.2 (0.4)	1.6 (0.1)	1.6 (0.1)	1.6 (0.1)	0.2 (0.0)	0.2 (0.0)	0.2 (0.0)
Dy	113.2 (2.1)	110.5 (2.6)	111.9 (2.7)	9.3 (0.3)	9.2 (0.3)	9.3 (0.2)	1.6 (0.1)	1.4 (0.1)	1.4 (0.1)
Ho	23.4 (0.4)	22.6 (0.5)	23.1 (0.5)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	0.4 (0.0)	0.3 (0.0)	0.4 (0.0)
Er	69.3 (1.4)	66.9 (1.2)	69.2 (1.2)	4.6 (0.2)	4.4 (0.2)	4.3 (0.2)	1.1 (0.1)	1.1 (0.1)	1.0 (0.1)
Tm	10.0 (0.2)	9.8 (0.2)	9.8 (0.2)	0.5 (0.0)	0.5 (0.0)	0.5 (0.0)	≤ LOD	≤ LOD	≤ LOD
Yb	60.0 (1.1)	56.4 (1.2)	57.9 (1.1)	2.6 (0.2)	2.5 (0.1)	2.4 (0.1)	0.9 (0.1)	1.0 (0.1)	1.1 (0.1)
Lu	7.2 (0.2)	7.1 (0.2)	7.1 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
∑REE + Y	1798 (9)	1753 (10)	1785 (10)	271 (2)	304 (3)	280 (3)	57 (1)	59 (1)	61 (1)
$(La/Lu)_{CN}$	1.67 (0.33)	1.65 (0.37)	1.64 (0.33)	8.91 (2.48)	12.00 (3.51)	10.35 (3.08)	7.94 (2.63)	7.77 (2.50)	7.87 (2.78)
$(La/Sm)_{CN}$	1.09 (0.22)	1.09 (0.23)	1.07 (0.22)	1.74 (0.37)	2.12 (0.50)	1.98 (0.48)	5.60 (1.65)	6.30 (1.94)	7.37 (2.61)
$(La/Y)_{CN}$	1.35 (0.25)	1.35 (0.26)	1.31 (0.26)	4.99 (0.92)	6.22 (1.29)	5.57 (1.18)	9.83 (2.28)	10.75 (2.33)	11.70 (2.76)
$Eu_A = Eu/Eu^*$	0.18 (0.01)	0.18 (0.01)	0.18 (0.01)	0.66 (0.04)	0.57 (0.04)	0.64 (0.04)	2.64 (0.28)	3.34 (0.42)	3.61 (0.48)
$Ce_A = Ce/Ce^*$	1.12 (0.05)	1.14 (0.06)	1.14 (0.06)	1.14 (0.06)	1.14 (0.06)	1.15 (0.06)	0.83 (0.05)	0.81 (0.04)	0.79 (0.05)

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TABLE E1. *(continued)*

Sample (ppm)	UK#1_37	UK#1_38	UK#1_39	UK#1_40	UK#1_41	UK#1_42	UK#1_43	UK#1_44	UK#1_45
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	2 (0)	≤ LOD	1 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	8.6 (0.7)	8.0 (0.5)	15.2 (0.6)	14.7 (0.7)	13.1 (0.4)	26.1 (0.9)	29.0 (0.9)	14.1 (0.5)	10.5 (0.5)
Fe	51 (39)	≤ LOD	7 (8)	16 (31)	≤ LOD	18 (13)	≤ LOD	≤ LOD	12 (12)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	8 (7)	≤ LOD	4 (3)	19 (18)	≤ LOD	9 (6)	≤ LOD	≤ LOD	7 (7)
Zn	69 (48)	≤ LOD	45 (29)	43 (36)	≤ LOD	65 (45)	≤ LOD	4 (5)	8 (6)
As	26 (13)	9 (2)	36 (15)	18 (3)	19 (5)	45 (33)	15 (5)	11 (2)	30 (14)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	341.7 (7.6)	342.9 (8.2)	755.0 (16.0)	729.0 (19.0)	743.0 (20.0)	493.0 (13.0)	532.0 (11.0)	508.8 (9.9)	48.2 (1.1)
Y	40.8 (1.1)	38.7 (0.7)	122.2 (2.3)	126.4 (2.7)	127.6 (2.8)	109.4 (2.4)	112.6 (2.6)	110.9 (2.4)	60.2 (1.0)
Nb	6 (0)	6 (0)	15 (0)	17 (0)	14 (0)	12 (0)	13 (0)	13 (0)	4 (0)
Mo	10 (1)	10 (0)	31 (1)	34 (1)	25 (1)	130 (3)	125 (2)	117 (3)	3 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	745000 (23000)	755000 (23000)	779000 (21000)	768000 (17000)	766000 (17000)	759000 (18000)	768000 (19000)	743000 (17000)	755000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	27.6 (0.6)	27.1 (0.6)	17.2 (0.3)	18.6 (0.4)	19.1 (0.4)	47.1 (1.1)	47.9 (1.0)	44.7 (0.8)	12.9 (0.3)
Ce	62.4 (1.5)	61.6 (1.7)	48.7 (1.0)	52.0 (1.1)	52.6 (1.0)	39.1 (0.9)	38.6 (0.9)	37.4 (0.5)	34.1 (0.6)
Pr	8.4 (0.2)	8.3 (0.3)	9.4 (0.2)	10.0 (0.3)	10.2 (0.3)	11.1 (0.3)	10.8 (0.3)	10.6 (0.2)	5.6 (0.1)
Nd	41.2 (1.2)	41.7 (1.2)	48.7 (1.2)	51.3 (1.5)	50.1 (1.3)	46.7 (1.3)	45.8 (1.3)	45.1 (1.0)	31.6 (0.9)
Sm	11.5 (0.5)	11.3 (0.4)	18.1 (0.5)	18.0 (0.5)	18.5 (0.6)	11.0 (0.4)	10.5 (0.4)	10.7 (0.4)	10.3 (0.4)
Eu	5.93 (0.19)	5.83 (0.23)	26.88 (0.55)	27.00 (0.78)	26.61 (0.67)	6.17 (0.23)	6.55 (0.19)	6.29 (0.19)	10.65 (0.28)
Gd	12.7 (0.4)	12.4 (0.6)	24.1 (0.7)	24.6 (0.8)	25.1 (0.7)	15.4 (0.6)	14.9 (0.4)	15.3 (0.5)	13.0 (0.4)
Tb	1.9 (0.1)	1.8 (0.1)	4.0 (0.1)	4.2 (0.1)	4.2 (0.1)	2.5 (0.1)	2.4 (0.1)	2.5 (0.1)	2.2 (0.1)
Dy	10.8 (0.3)	10.3 (0.3)	25.1 (0.7)	26.5 (0.7)	26.2 (0.7)	18.3 (0.5)	17.8 (0.5)	18.2 (0.4)	13.8 (0.3)
Ho	1.9 (0.1)	1.8 (0.1)	4.7 (0.1)	4.8 (0.1)	4.9 (0.1)	4.2 (0.1)	4.1 (0.1)	4.3 (0.1)	2.4 (0.1)
Er	4.6 (0.2)	4.2 (0.2)	12.0 (0.3)	12.7 (0.3)	12.9 (0.3)	13.1 (0.4)	12.8 (0.4)	12.8 (0.3)	5.5 (0.1)
Tm	0.5 (0.0)	0.4 (0.0)	1.5 (0.1)	1.5 (0.1)	1.6 (0.1)	1.6 (0.0)	1.7 (0.0)	1.7 (0.1)	0.6 (0.0)
Yb	2.2 (0.2)	2.0 (0.1)	7.8 (0.3)	8.1 (0.3)	8.2 (0.3)	8.3 (0.3)	8.7 (0.3)	8.4 (0.3)	2.6 (0.1)
Lu	≤ LOD	≤ LOD	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.1 (0.0)	1.1 (0.0)	≤ LOD
∑REE + Y	233 (2)	228 (2)	371 (2)	387 (2)	389 (2)	335 (2)	336 (2)	330 (2)	206 (1)
$(La/Lu)_{CN}$	10.13 (3.20)	11.43 (3.72)	1.83 (0.38)	1.85 (0.48)	1.88 (0.46)	4.79 (1.21)	4.52 (1.13)	4.29 (1.04)	4.77 (1.47)
$(La/Sm)_{CN}$	1.50 (0.38)	1.50 (0.34)	0.60 (0.12)	0.65 (0.15)	0.65 (0.15)	2.69 (0.66)	2.86 (0.69)	2.61 (0.60)	0.79 (0.19)
$(La/Y)_{CN}$	4.49 (0.99)	4.65 (0.92)	0.94 (0.17)	0.98 (0.20)	0.99 (0.20)	2.86 (0.61)	2.83 (0.59)	2.68 (0.53)	1.43 (0.27)
$Eu_A = Eu/Eu^*$	1.48 (0.10)	1.49 (0.11)	3.91 (0.20)	3.89 (0.22)	3.75 (0.21)	1.44 (0.10)	1.59 (0.10)	1.49 (0.09)	2.79 (0.17)
$Ce_A = Ce/Ce^*$	0.98 (0.05)	0.98 (0.06)	0.90 (0.05)	0.90 (0.05)	0.89 (0.05)	0.40 (0.02)	0.39 (0.02)	0.40 (0.02)	0.96 (0.05)

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TABLE E1. *(continued)*

Sample (ppm)	UK#1_46	UK#1_47	UK#1_48	UK#1_49	UK#1_50	UK#1_51	UK#1_52	UK#1_53
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (3)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	11.2 (0.5)	11.0 (0.6)	3.7 (0.4)	4.0 (0.5)	4.2 (0.4)	12.0 (0.9)	12.3 (0.7)	5.9 (0.6)
Fe	≤ LOD	≤ LOD	14 (9)	6 (8)	2 (6)	230 (150)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	6 (5)	7 (5)	5 (6)	≤ LOD	16 (10)	4 (3)	≤ LOD
Zn	7 (7)	19 (16)	36 (24)	3 (4)	10 (10)	119 (56)	≤ LOD	2 (2)
As	9 (2)	12 (3)	38 (17)	19 (11)	19 (7)	73 (22)	17 (5)	13 (3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	53.4 (1.0)	50.6 (0.9)	97.5 (2.0)	88.3 (2.1)	87.3 (1.7)	232.0 (4.1)	234.7 (4.5)	237.2 (5.0)
Y	61.5 (1.0)	62.5 (1.3)	12.6 (0.3)	14.7 (0.4)	14.0 (0.3)	119.7 (2.0)	125.8 (2.6)	117.6 (1.8)
Nb	3 (0)	3 (0)	2 (0)	2 (0)	2 (0)	30 (1)	32 (1)	30 (1)
Mo	3 (0)	3 (0)	35 (1)	35 (1)	33 (1)	164 (3)	172 (3)	168 (3)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	769000 (18000)	758000 (19000)	801000 (18000)	771000 (17000)	774000 (18000)	770000 (20000)	776000 (16000)	768000 (15000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	13.8 (0.3)	13.9 (0.3)	9.5 (0.2)	7.7 (0.2)	7.5 (0.2)	68.8 (1.2)	71.4 (1.2)	65.1 (1.5)
Ce	34.7 (0.6)	36.1 (0.8)	12.5 (0.3)	10.7 (0.3)	10.4 (0.2)	39.0 (0.8)	40.9 (0.8)	38.1 (0.8)
Pr	5.8 (0.1)	5.8 (0.1)	1.4 (0.1)	1.2 (0.1)	1.2 (0.0)	15.4 (0.3)	16.3 (0.3)	15.4 (0.3)
Nd	31.6 (0.8)	31.5 (0.9)	6.8 (0.3)	6.7 (0.3)	6.3 (0.3)	77.6 (1.5)	79.1 (1.5)	75.2 (1.3)
Sm	10.5 (0.3)	10.5 (0.4)	1.6 (0.1)	1.6 (0.1)	1.6 (0.1)	13.9 (0.5)	14.6 (0.4)	13.5 (0.4)
Eu	12.51 (0.30)	11.93 (0.33)	0.53 (0.04)	0.54 (0.04)	0.50 (0.04)	4.13 (0.16)	4.28 (0.14)	4.19 (0.12)
Gd	12.7 (0.5)	13.3 (0.5)	2.8 (0.2)	3.1 (0.2)	2.8 (0.2)	19.0 (0.5)	19.9 (0.5)	18.6 (0.6)
Tb	2.1 (0.1)	2.2 (0.1)	0.4 (0.0)	0.4 (0.0)	0.4 (0.0)	2.4 (0.1)	2.6 (0.1)	2.4 (0.1)
Dy	14.0 (0.3)	14.2 (0.4)	2.4 (0.1)	2.9 (0.1)	2.7 (0.1)	16.6 (0.5)	17.3 (0.5)	16.9 (0.4)
Ho	2.4 (0.1)	2.4 (0.1)	0.6 (0.0)	0.7 (0.0)	0.7 (0.0)	3.9 (0.1)	3.9 (0.1)	4.0 (0.1)
Er	5.5 (0.2)	5.7 (0.2)	1.6 (0.1)	2.0 (0.1)	2.0 (0.1)	10.3 (0.3)	10.7 (0.3)	11.1 (0.2)
Tm	0.6 (0.0)	0.6 (0.0)	≤ LOD	≤ LOD	≤ LOD	1.1 (0.1)	1.2 (0.0)	1.1 (0.0)
Yb	2.7 (0.1)	2.8 (0.1)	1.2 (0.1)	1.2 (0.1)	1.2 (0.1)	5.3 (0.2)	5.2 (0.2)	4.9 (0.1)
Lu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.6 (0.0)	0.7 (0.0)	0.6 (0.0)
∑REE + Y	211 (1)	214 (1)	54 (1)	54 (1)	52 (0)	398 (2)	414 (2)	389 (2)
$(La/Lu)_{CN}$	5.27 (1.59)	4.66 (1.43)	4.59 (1.50)	3.43 (1.14)	3.27 (1.00)	11.36 (3.11)	11.12 (2.73)	10.96 (2.80)
$(La/Sm)_{CN}$	0.83 (0.18)	0.83 (0.20)	3.81 (1.24)	3.09 (0.98)	2.91 (0.87)	3.10 (0.69)	3.06 (0.63)	3.03 (0.72)
$(La/Y)_{CN}$	1.50 (0.29)	1.48 (0.31)	4.99 (1.05)	3.50 (0.78)	3.57 (0.74)	3.82 (0.71)	3.77 (0.73)	3.68 (0.72)
$Eu_A = Eu/Eu^*$	3.29 (0.19)	3.07 (0.19)	0.76 (0.09)	0.73 (0.09)	0.71 (0.08)	0.77 (0.05)	0.76 (0.04)	0.80 (0.05)
$Ce_A = Ce/Ce^*$	0.93 (0.05)	0.96 (0.05)	0.74 (0.04)	0.76 (0.05)	0.76 (0.04)	0.28 (0.01)	0.28 (0.01)	0.28 (0.01)

TABLE E2. Major and trace element compositions of scheelite from UK #2 (MPB-13-002).

Sample (ppm)	UK#2_1	UK#2_2	UK#2_3	UK#2_4	UK#2_5	UK#2_6	UK#2_7	UK#2_8	UK#2_9
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	20.0 (0.7)	19.5 (0.7)	20.8 (0.8)	24.0 (1.0)	28.6 (2.4)	29.0 (1.0)	21.6 (0.7)	12.1 (0.5)	16.3 (0.8)
Fe	13 (11)	≤ LOD	≤ LOD	15 (11)	210 (110)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	3 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	40 (30)	≤ LOD	≤ LOD	8 (7)	8 (11)	≤ LOD	4 (4)	≤ LOD	3 (4)
Zn	52 (58)	4 (3)	≤ LOD	26 (19)	7 (6)	≤ LOD	3 (2)	8 (8)	7 (7)
As	34 (18)	15 (8)	12 (4)	22 (9)	11 (3)	7 (1)	11 (5)	11 (3)	9 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	55.3 (0.8)	55.3 (1.3)	56.3 (1.4)	57.4 (1.6)	58.8 (1.3)	59.9 (1.4)	55.6 (1.3)	57.4 (1.6)	62.8 (1.5)
Y	544.0 (11.0)	417.0 (16.0)	563.0 (17.0)	1137.0 (33.0)	800.0 (28.0)	1112.0 (30.0)	310.6 (9.9)	439.0 (15.0)	287.7 (6.9)
Nb	143 (2)	113 (3)	186 (3)	299 (6)	303 (6)	284 (6)	59 (2)	125 (7)	62 (1)
Mo	15 (1)	15 (1)	16 (0)	12 (0)	12 (0)	10 (0)	11 (1)	12 (0)	10 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	747000 (15000)	733000 (16000)	723000 (12000)	743000 (17000)	739000 (15000)	735000 (19000)	739000 (18000)	736000 (22000)	741000 (17000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	9.0 (0.7)	6.9 (0.3)	9.9 (0.2)	13.8 (0.3)	12.9 (0.4)	17.2 (0.4)	9.0 (0.2)	6.8 (0.2)	7.3 (0.2)
Ce	44.4 (2.9)	35.2 (1.3)	48.5 (0.8)	65.8 (1.4)	63.8 (1.4)	81.3 (1.5)	42.9 (1.1)	34.5 (1.0)	39.4 (0.9)
Pr	10.9 (0.7)	9.1 (0.3)	12.2 (0.3)	16.5 (0.4)	16.5 (0.5)	19.7 (0.6)	9.7 (0.2)	8.2 (0.2)	9.8 (0.2)
Nd	74.4 (3.3)	64.9 (2.0)	84.8 (2.1)	117.8 (2.6)	114.0 (3.5)	129.6 (3.0)	62.0 (2.1)	60.6 (1.9)	66.6 (1.5)
Sm	33.3 (1.2)	28.9 (1.0)	37.3 (1.0)	57.6 (1.5)	54.5 (1.6)	59.5 (2.0)	22.2 (0.8)	32.8 (1.0)	25.1 (0.8)
Eu	14.76 (0.37)	16.37 (0.44)	15.01 (0.36)	15.06 (0.44)	14.33 (0.38)	20.85 (0.53)	11.20 (0.38)	9.30 (0.28)	8.79 (0.30)
Gd	53.3 (1.4)	45.2 (1.4)	65.2 (1.6)	109.4 (2.9)	101.2 (3.1)	109.9 (3.2)	31.9 (1.1)	58.2 (2.4)	33.4 (1.0)
Tb	10.5 (0.2)	8.4 (0.2)	11.9 (0.3)	23.3 (0.7)	19.9 (0.6)	22.6 (0.8)	5.8 (0.2)	10.9 (0.4)	5.8 (0.2)
Dy	83.7 (2.0)	64.5 (2.2)	93.3 (2.5)	189.5 (5.9)	154.2 (4.5)	178.2 (5.0)	46.2 (1.7)	81.8 (3.0)	44.9 (0.9)
Ho	20.3 (0.4)	15.4 (0.6)	22.2 (0.5)	45.4 (1.5)	35.3 (1.2)	42.6 (1.2)	10.5 (0.4)	18.3 (0.7)	10.5 (0.3)
Er	66.0 (1.4)	50.0 (2.4)	69.9 (1.7)	140.3 (4.9)	103.5 (3.9)	134.3 (3.5)	34.3 (1.0)	54.0 (1.8)	33.5 (0.8)
Tm	9.5 (0.2)	7.4 (0.5)	9.3 (0.3)	18.7 (0.7)	13.2 (0.5)	19.2 (0.6)	4.9 (0.2)	7.0 (0.3)	4.7 (0.1)
Yb	58.2 (1.2)	45.4 (3.2)	55.5 (1.8)	109.0 (4.1)	70.7 (3.0)	119.8 (4.3)	30.6 (1.0)	40.3 (1.4)	29.0 (0.7)
Lu	9.2 (0.2)	7.2 (0.6)	8.6 (0.3)	16.0 (0.6)	10.5 (0.4)	17.4 (0.6)	4.5 (0.1)	5.8 (0.2)	4.7 (0.1)
∑REE + Y	1041 (6)	822 (6)	1107 (5)	2075 (10)	1585 (9)	2084 (9)	636 (4)	868 (5)	611 (3)
$(La/Lu)_{CN}$	0.10 (0.03)	0.10 (0.04)	0.12 (0.04)	0.09 (0.03)	0.13 (0.04)	0.10 (0.03)	0.21 (0.07)	0.12 (0.04)	0.16 (0.05)
$(La/Sm)_{CN}$	0.17 (0.06)	0.15 (0.05)	0.17 (0.05)	0.15 (0.05)	0.15 (0.05)	0.18 (0.06)	0.25 (0.09)	0.13 (0.04)	0.18 (0.06)
$(La/Y)_{CN}$	0.11 (0.03)	0.11 (0.04)	0.12 (0.04)	0.08 (0.03)	0.11 (0.04)	0.10 (0.03)	0.19 (0.06)	0.10 (0.03)	0.17 (0.05)
$Eu_A = Eu/Eu^*$	1.06 (0.06)	1.37 (0.08)	0.92 (0.05)	0.57 (0.03)	0.58 (0.03)	0.77 (0.04)	1.28 (0.08)	0.64 (0.04)	0.92 (0.06)
$Ce_A = Ce/Ce^*$	0.92 (0.11)	0.89 (0.07)	0.90 (0.05)	0.90 (0.05)	0.88 (0.06)	0.92 (0.06)	0.97 (0.06)	0.95 (0.06)	0.92 (0.06)

(continued on next page)

TABLE E2. *(continued)*

Sample (ppm)	UK#2_10	UK#2_11	UK#2_12	UK#2_13	UK#2_14	UK#2_15	UK#2_16	UK#2_17	UK#2_18
Li	≤ LOD	≤ LOD	≤ LOD	1 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	13.9 (0.5)	14.6 (0.5)	14.3 (0.5)	12.0 (0.5)	13.8 (0.5)	13.7 (0.6)	22.7 (0.9)	23.0 (0.6)	19.1 (2.2)
Fe	2 (5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	11 (10)	6 (7)	2 (3)	22 (29)	2 (2)	3 (4)	7 (5)	2 (4)	≤ LOD
As	12 (5)	10 (3)	8 (2)	9 (2)	7 (1)	8 (0)	8 (2)	6 (0)	13 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	57.2 (1.4)	56.8 (1.2)	55.9 (1.1)	48.4 (1.1)	49.6 (1.0)	50.6 (1.0)	61.1 (1.7)	58.8 (1.1)	61.5 (1.5)
Y	1081.0 (23.0)	1137.0 (21.0)	988.0 (18.0)	1182.0 (23.0)	1230.0 (27.0)	1380.0 (54.0)	207.3 (4.7)	186.4 (3.0)	530.0 (18.0)
Nb	87 (2)	118 (2)	98 (2)	208 (6)	137 (3)	182 (3)	98 (3)	55 (1)	167 (5)
Mo	15 (1)	16 (1)	17 (1)	19 (1)	14 (1)	15 (1)	10 (0)	11 (1)	9 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	730000 (17000)	747000 (16000)	750000 (15000)	756000 (18000)	754000 (20000)	761000 (19000)	784000 (23000)	753000 (17000)	768000 (19000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	17.6 (0.3)	19.4 (0.3)	20.5 (0.4)	3.9 (0.1)	10.7 (0.3)	11.3 (0.2)	6.6 (0.2)	6.2 (0.2)	8.7 (0.2)
Ce	90.4 (1.9)	92.4 (2.0)	91.1 (1.6)	27.0 (0.5)	63.9 (1.4)	65.3 (1.5)	32.0 (0.9)	26.3 (0.5)	40.2 (0.9)
Pr	22.9 (0.6)	23.3 (0.5)	21.4 (0.5)	9.6 (0.2)	18.5 (0.5)	19.4 (0.5)	7.1 (0.3)	5.7 (0.2)	10.4 (0.3)
Nd	135.6 (3.6)	140.4 (3.0)	118.6 (2.5)	83.1 (1.8)	131.8 (3.9)	133.9 (3.1)	45.4 (1.4)	38.3 (0.8)	79.3 (2.3)
Sm	50.7 (1.6)	54.4 (1.4)	41.2 (1.0)	48.6 (1.4)	57.6 (1.7)	65.3 (2.0)	15.5 (0.7)	14.4 (0.5)	46.5 (1.5)
Eu	29.05 (0.84)	28.95 (0.79)	30.91 (0.66)	12.38 (0.27)	22.43 (0.61)	23.07 (0.66)	6.47 (0.24)	7.01 (0.22)	10.10 (0.35)
Gd	74.2 (2.1)	87.1 (2.4)	59.9 (1.4)	102.1 (2.9)	102.0 (3.5)	116.4 (3.2)	23.5 (0.8)	22.6 (0.7)	88.3 (3.0)
Tb	15.1 (0.4)	17.5 (0.4)	12.7 (0.3)	21.3 (0.5)	20.3 (0.5)	23.7 (0.8)	4.1 (0.2)	4.1 (0.1)	16.7 (0.6)
Dy	128.3 (3.0)	146.8 (3.3)	110.3 (2.3)	179.1 (4.3)	167.3 (3.7)	200.2 (7.0)	32.0 (1.0)	30.3 (0.6)	119.5 (3.8)
Ho	33.7 (0.7)	38.2 (0.7)	29.2 (0.6)	46.8 (1.0)	43.8 (1.1)	51.0 (1.8)	7.8 (0.2)	7.0 (0.2)	24.3 (0.8)
Er	125.7 (2.4)	134.9 (2.2)	111.7 (2.5)	159.0 (2.8)	157.9 (3.4)	177.3 (6.6)	24.3 (0.7)	21.3 (0.5)	64.3 (2.4)
Tm	22.2 (0.5)	22.1 (0.4)	20.2 (0.4)	22.6 (0.4)	25.0 (0.6)	26.8 (1.1)	3.3 (0.1)	2.7 (0.1)	7.4 (0.4)
Yb	168.7 (3.8)	157.9 (3.4)	155.8 (3.0)	139.3 (2.4)	169.9 (4.0)	180.0 (7.9)	19.2 (0.7)	15.5 (0.5)	36.9 (1.9)
Lu	31.1 (0.7)	27.7 (0.7)	28.4 (0.6)	23.4 (0.4)	29.7 (0.7)	29.0 (1.1)	3.1 (0.1)	2.4 (0.1)	4.6 (0.2)
∑REE + Y	2026 (7)	2128 (7)	1840 (6)	2060 (7)	2251 (9)	2503 (14)	438 (2)	390 (2)	1087 (7)
$(La/Lu)_{CN}$	0.06 (0.02)	0.07 (0.02)	0.07 (0.02)	0.02 (0.01)	0.04 (0.01)	0.04 (0.01)	0.22 (0.08)	0.27 (0.09)	0.20 (0.07)
$(La/Sm)_{CN}$	0.22 (0.07)	0.22 (0.07)	0.31 (0.10)	0.05 (0.02)	0.12 (0.04)	0.11 (0.04)	0.27 (0.09)	0.27 (0.09)	0.12 (0.04)
$(La/Y)_{CN}$	0.11 (0.03)	0.11 (0.04)	0.14 (0.04)	0.02 (0.01)	0.06 (0.02)	0.05 (0.02)	0.21 (0.07)	0.22 (0.07)	0.11 (0.04)
$Eu_A = Eu/Eu^*$	1.44 (0.08)	1.27 (0.07)	1.89 (0.09)	0.52 (0.03)	0.88 (0.05)	0.80 (0.04)	1.03 (0.07)	1.18 (0.07)	0.47 (0.03)
$Ce_A = Ce/Ce^*$	0.90 (0.06)	0.89 (0.05)	0.92 (0.05)	0.72 (0.04)	0.84 (0.05)	0.82 (0.05)	0.98 (0.07)	0.97 (0.06)	0.87 (0.05)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_19	UK#2_20	UK#2_21	UK#2_22	UK#2_23	UK#2_24	UK#2_25	UK#2_26	UK#2_27
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	19 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	26.3 (0.7)	25.5 (0.8)	25.7 (0.7)	19.5 (0.7)	18.4 (0.6)	23.2 (0.7)	11.3 (0.9)	14.1 (5.4)	10.6 (0.9)
Fe	181 (34)	2 (6)	34 (10)	21 (11)	≤ LOD	≤ LOD	14 (9)	45 (31)	4 (8)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (2)	3 (3)	25 (13)	≤ LOD	6 (4)
Zn	5 (5)	10 (9)	3 (3)	38 (22)	6 (5)	7 (6)	30 (19)	14 (7)	15 (8)
As	11 (2)	11 (2)	9 (1)	50 (28)	30 (12)	37 (17)	38 (19)	11 (1)	12 (4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	61.3 (1.4)	62.5 (1.4)	61.7 (1.5)	58.8 (1.1)	62.7 (1.2)	61.3 (1.3)	59.4 (1.5)	65.2 (1.6)	69.8 (1.8)
Y	1461.0 (49.0)	1497.0 (40.0)	1524.0 (48.0)	1452.0 (80.0)	1571.0 (45.0)	1630.0 (71.0)	612.0 (12.0)	491.0 (17.0)	371.5 (6.2)
Nb	390 (8)	408 (9)	517 (13)	166 (5)	188 (4)	212 (5)	170 (3)	102 (2)	89 (2)
Mo	12 (1)	11 (1)	11 (0)	10 (0)	9 (0)	9 (0)	11 (1)	9 (1)	8 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	779000 (17000)	770000 (19000)	774000 (21000)	782000 (13000)	772000 (18000)	773000 (18000)	760000 (18000)	763000 (19000)	769000 (17000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	12.2 (0.3)	15.9 (0.4)	17.4 (0.3)	4.7 (0.1)	5.7 (0.1)	5.6 (0.1)	6.9 (0.2)	4.1 (0.1)	3.3 (0.1)
Ce	60.7 (1.2)	79.6 (2.2)	86.3 (1.8)	43.4 (0.6)	52.0 (1.0)	49.9 (1.4)	41.6 (0.9)	27.8 (0.6)	22.1 (0.5)
Pr	15.9 (0.3)	19.8 (0.6)	20.7 (0.4)	16.4 (0.5)	20.0 (0.4)	20.4 (0.6)	11.3 (0.3)	9.0 (0.3)	7.2 (0.2)
Nd	117.9 (2.8)	136.4 (3.8)	147.8 (4.4)	154.5 (4.9)	180.9 (4.4)	194.3 (6.0)	75.4 (2.1)	76.2 (1.9)	57.8 (1.4)
Sm	63.8 (1.4)	78.9 (1.9)	92.2 (2.7)	110.2 (4.0)	124.6 (3.0)	143.0 (5.6)	34.4 (0.9)	57.0 (1.9)	39.4 (0.9)
Eu	23.06 (0.66)	29.29 (0.79)	31.50 (0.96)	19.65 (0.57)	25.82 (0.63)	27.87 (0.78)	12.90 (0.39)	11.57 (0.42)	9.70 (0.24)
Gd	127.8 (3.0)	129.9 (4.3)	153.2 (5.3)	194.3 (6.6)	215.7 (4.4)	239.4 (8.5)	53.8 (1.5)	86.0 (2.9)	58.8 (1.6)
Tb	27.0 (0.7)	31.3 (0.9)	35.6 (1.1)	40.6 (1.7)	44.2 (0.9)	49.1 (1.9)	11.2 (0.3)	17.1 (0.6)	11.8 (0.3)
Dy	229.0 (6.3)	260.1 (7.6)	291.5 (9.1)	305.0 (14.0)	332.9 (6.7)	369.0 (15.0)	93.1 (2.2)	116.8 (3.5)	83.9 (1.8)
Ho	59.5 (1.8)	57.5 (1.7)	63.8 (1.9)	64.7 (3.3)	68.6 (1.9)	73.7 (3.1)	22.1 (0.6)	21.6 (0.8)	15.9 (0.4)
Er	194.4 (6.9)	184.8 (5.2)	198.3 (6.6)	184.0 (11.0)	194.8 (6.0)	206.3 (9.0)	71.7 (1.5)	58.2 (2.3)	45.5 (0.9)
Tm	28.5 (1.2)	29.9 (1.0)	29.6 (0.8)	23.7 (1.5)	24.8 (0.9)	27.1 (1.4)	10.0 (0.2)	7.7 (0.2)	6.3 (0.2)
Yb	181.3 (8.2)	199.2 (8.2)	180.1 (5.0)	134.9 (8.8)	135.1 (6.8)	154.3 (9.8)	58.9 (1.3)	44.7 (2.7)	36.0 (0.7)
Lu	26.2 (1.2)	24.5 (1.1)	21.2 (0.7)	15.6 (1.0)	15.6 (1.0)	16.3 (0.9)	8.7 (0.2)	5.0 (0.3)	4.2 (0.1)
∑REE + Y	2628 (13)	2774 (14)	2893 (15)	2764 (22)	3012 (14)	3206 (24)	1124 (4)	1034 (7)	773 (3)
$(La/Lu)_{CN}$	0.05 (0.02)	0.07 (0.02)	0.08 (0.03)	0.03 (0.01)	0.04 (0.01)	0.04 (0.01)	0.08 (0.03)	0.08 (0.03)	0.08 (0.03)
$(La/Sm)_{CN}$	0.12 (0.04)	0.13 (0.04)	0.12 (0.04)	0.03 (0.01)	0.03 (0.01)	0.02 (0.01)	0.12 (0.04)	0.04 (0.02)	0.05 (0.02)
$(La/Y)_{CN}$	0.06 (0.02)	0.07 (0.02)	0.08 (0.03)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.07 (0.02)	0.06 (0.02)	0.06 (0.02)
Eu_A = Eu/Eu*	0.76 (0.04)	0.87 (0.05)	0.80 (0.05)	0.40 (0.03)	0.47 (0.02)	0.45 (0.03)	0.91 (0.05)	0.50 (0.03)	0.61 (0.03)
Ce_A = Ce/Ce*	0.87 (0.05)	0.91 (0.06)	0.93 (0.05)	0.71 (0.05)	0.69 (0.04)	0.66 (0.05)	0.88 (0.06)	0.78 (0.05)	0.78 (0.05)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_28	UK#2_29	UK#2_30	UK#2_31	UK#2_32	UK#2_33	UK#2_34	UK#2_35	UK#2_36
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	26.5 (0.8)	26.0 (0.8)	25.5 (0.8)	19.6 (0.6)	21.3 (0.6)	14.2 (0.5)	23.1 (1.1)	15.2 (0.6)	33.9 (4.2)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	61 (23)	≤ LOD	2 (6)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1)	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (1)	≤ LOD	≤ LOD
Zn	2 (3)	≤ LOD	≤ LOD	≤ LOD	6 (7)	3 (3)	2 (1)	≤ LOD	2 (2)
As	11 (3)	8 (0)	9 (1)	11 (3)	7 (1)	7 (0)	11 (2)	10 (2)	13 (3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	63.5 (1.5)	63.8 (1.6)	62.5 (1.4)	56.2 (1.3)	59.9 (1.3)	60.8 (1.2)	56.2 (1.4)	59.3 (1.2)	62.0 (1.3)
Y	1303.0 (39.0)	1049.0 (33.0)	1276.0 (27.0)	217.0 (9.0)	497.9 (8.6)	1046.0 (30.0)	1318.0 (26.0)	1164.0 (22.0)	1780.0 (160.0)
Nb	476 (11)	376 (9)	466 (9)	75 (4)	166 (2)	375 (11)	413 (8)	419 (8)	365 (7)
Mo	12 (1)	12 (0)	11 (0)	12 (0)	11 (0)	11 (0)	12 (1)	12 (0)	11 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	775000 (19000)	771000 (20000)	763000 (18000)	754000 (14000)	764000 (16000)	762000 (18000)	747000 (19000)	754000 (15000)	768000 (20000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	12.7 (0.3)	43.9 (7.4)	14.9 (0.3)	6.8 (0.3)	5.5 (0.1)	8.4 (0.2)	8.4 (0.2)	8.1 (0.2)	9.4 (0.6)
Ce	63.4 (1.4)	116.0 (13.0)	77.7 (1.4)	33.1 (1.1)	28.8 (0.5)	44.7 (1.0)	46.7 (1.0)	47.4 (1.1)	57.8 (2.9)
Pr	16.2 (0.4)	23.3 (1.7)	21.5 (0.5)	7.7 (0.2)	7.2 (0.2)	12.0 (0.3)	13.0 (0.3)	13.6 (0.3)	17.2 (0.8)
Nd	114.7 (3.8)	150.0 (7.4)	160.3 (4.6)	50.6 (1.6)	46.1 (1.1)	88.9 (2.4)	99.2 (2.5)	105.5 (2.3)	139.3 (6.6)
Sm	63.7 (2.0)	71.6 (2.8)	100.5 (2.4)	19.5 (1.0)	19.6 (0.7)	50.6 (1.5)	60.8 (1.5)	72.5 (1.9)	86.3 (4.8)
Eu	19.62 (0.57)	20.80 (0.58)	27.31 (0.68)	7.87 (0.26)	10.32 (0.25)	12.73 (0.32)	10.87 (0.31)	11.68 (0.35)	12.50 (0.43)
Gd	114.0 (4.2)	118.9 (4.0)	174.9 (4.0)	30.7 (1.3)	33.4 (0.8)	100.8 (2.5)	124.8 (3.3)	146.5 (4.1)	166.8 (9.9)
Tb	25.4 (0.8)	23.3 (0.7)	36.1 (0.9)	5.1 (0.3)	7.5 (0.2)	21.4 (0.6)	28.0 (0.6)	31.1 (0.8)	37.4 (2.6)
Dy	219.8 (6.6)	186.6 (6.4)	273.2 (6.2)	37.6 (2.0)	66.5 (1.3)	177.6 (5.4)	235.2 (4.6)	245.1 (6.6)	318.0 (24.0)
Ho	52.8 (1.7)	43.1 (1.4)	57.7 (1.0)	8.4 (0.4)	15.9 (0.3)	41.2 (1.2)	55.1 (1.0)	53.2 (1.1)	75.7 (5.9)
Er	171.6 (5.6)	135.0 (4.4)	165.4 (3.1)	24.6 (1.2)	53.5 (1.0)	126.8 (3.3)	169.9 (3.0)	152.3 (2.9)	243.0 (21.0)
Tm	25.2 (0.9)	18.3 (0.5)	22.1 (0.5)	3.2 (0.1)	7.8 (0.2)	16.8 (0.5)	22.2 (0.5)	19.6 (0.4)	33.1 (3.4)
Yb	156.3 (6.4)	109.6 (3.6)	121.9 (3.1)	20.1 (0.7)	48.0 (1.0)	92.3 (2.6)	127.9 (2.4)	105.9 (2.4)	195.0 (22.0)
Lu	21.7 (0.9)	15.5 (0.5)	15.1 (0.4)	3.2 (0.1)	6.7 (0.2)	13.6 (0.4)	16.3 (0.4)	12.7 (0.3)	25.2 (2.7)
∑REE + Y	2380 (13)	2125 (20)	2545 (10)	475 (4)	855 (3)	1854 (8)	2336 (8)	2189 (9)	3197 (42)
$(La/Lu)_{CN}$	0.06 (0.02)	0.29 (0.10)	0.10 (0.03)	0.22 (0.08)	0.08 (0.03)	0.06 (0.02)	0.05 (0.02)	0.07 (0.02)	0.04 (0.02)
$(La/Sm)_{CN}$	0.13 (0.04)	0.38 (0.13)	0.09 (0.03)	0.22 (0.08)	0.17 (0.06)	0.10 (0.03)	0.09 (0.03)	0.07 (0.02)	0.07 (0.03)
$(La/Y)_{CN}$	0.06 (0.02)	0.28 (0.09)	0.08 (0.02)	0.21 (0.07)	0.07 (0.02)	0.05 (0.02)	0.04 (0.01)	0.05 (0.01)	0.04 (0.01)
$Eu_A = Eu/Eu^*$	0.69 (0.04)	0.68 (0.04)	0.62 (0.03)	0.97 (0.08)	1.22 (0.06)	0.53 (0.03)	0.37 (0.02)	0.34 (0.02)	0.31 (0.03)
$Ce_A = Ce/Ce^*$	0.89 (0.05)	0.86 (0.17)	0.85 (0.05)	0.96 (0.07)	0.91 (0.05)	0.87 (0.06)	0.85 (0.05)	0.84 (0.05)	0.82 (0.09)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_37	UK#2_38	UK#2_39	UK#2_40	UK#2_41	UK#2_42	UK#2_43	UK#2_44	UK#2_45
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	25.9 (1.0)	25.2 (0.9)	26.3 (1.5)	13.2 (0.6)	14.0 (0.6)	14.0 (0.5)	25.6 (0.7)	28.1 (0.9)	27.3 (0.6)
Fe	10 (12)	≤ LOD	4 (4)	14 (26)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	10 (9)	≤ LOD	≤ LOD	3 (3)	14 (18)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	37 (35)	≤ LOD	2 (2)	≤ LOD	15 (16)	≤ LOD	3 (4)	≤ LOD	2 (2)
As	17 (7)	10 (1)	15 (4)	13 (5)	8 (2)	9 (2)	10 (1)	9 (1)	11 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	63.5 (1.5)	63.8 (1.1)	65.3 (1.2)	55.4 (1.3)	57.7 (1.2)	58.5 (1.6)	60.4 (1.2)	60.5 (1.2)	60.8 (1.5)
Y	1323.0 (29.0)	1527.0 (70.0)	2210.0 (270.0)	783.0 (18.0)	684.0 (13.0)	755.0 (17.0)	1478.0 (28.0)	1704.0 (41.0)	1847.0 (76.0)
Nb	486 (8)	452 (8)	425 (8)	69 (1)	64 (1)	71 (2)	471 (9)	409 (8)	429 (10)
Mo	11 (0)	11 (0)	11 (0)	16 (1)	16 (1)	16 (1)	12 (0)	12 (0)	10 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	757000 (16000)	773000 (14000)	777000 (15000)	767000 (16000)	770000 (15000)	776000 (16000)	791000 (19000)	784000 (14000)	784000 (14000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	13.8 (0.3)	16.4 (0.5)	15.1 (0.5)	15.4 (0.3)	17.5 (0.3)	16.9 (0.4)	15.7 (0.4)	15.4 (0.3)	17.9 (0.3)
Ce	74.0 (1.4)	83.6 (1.9)	83.7 (3.3)	67.9 (1.4)	69.1 (1.1)	70.0 (1.5)	73.0 (1.2)	72.0 (1.6)	86.5 (1.9)
Pr	21.5 (0.5)	22.8 (0.5)	23.1 (1.0)	15.5 (0.3)	15.0 (0.4)	15.5 (0.4)	18.0 (0.5)	17.1 (0.3)	22.2 (0.6)
Nd	163.9 (4.4)	163.3 (2.9)	173.7 (8.8)	83.1 (2.3)	75.1 (1.9)	77.1 (2.1)	123.1 (3.2)	112.2 (2.7)	159.5 (4.2)
Sm	107.9 (3.0)	93.2 (2.0)	110.7 (7.2)	30.1 (0.8)	26.0 (0.9)	27.6 (0.7)	65.9 (1.5)	56.9 (1.5)	106.3 (3.1)
Eu	25.01 (0.65)	26.49 (0.53)	29.90 (0.85)	28.66 (0.67)	29.33 (0.83)	28.16 (0.92)	23.10 (0.59)	22.78 (0.58)	31.98 (0.80)
Gd	177.0 (4.2)	163.9 (3.6)	205.0 (15.0)	43.0 (1.2)	38.8 (0.9)	39.2 (1.1)	130.4 (3.6)	98.4 (2.7)	163.6 (5.0)
Tb	39.0 (0.9)	34.8 (1.0)	48.0 (4.1)	9.4 (0.3)	8.2 (0.2)	8.6 (0.2)	27.6 (0.7)	25.1 (0.6)	38.0 (1.1)
Dy	293.5 (7.3)	283.0 (10.0)	401.0 (41.0)	86.5 (2.3)	74.3 (2.0)	80.5 (2.0)	235.1 (4.0)	227.9 (5.5)	318.0 (10.0)
Ho	58.3 (1.4)	63.7 (2.6)	88.8 (9.4)	22.5 (0.6)	20.3 (0.5)	21.5 (0.4)	58.6 (1.1)	56.6 (1.2)	68.8 (2.5)
Er	167.3 (3.2)	197.2 (8.2)	270.0 (29.0)	88.9 (2.0)	78.9 (1.8)	83.0 (1.5)	190.3 (3.8)	201.9 (4.7)	222.1 (8.9)
Tm	22.7 (0.5)	27.1 (1.3)	43.8 (6.0)	16.3 (0.4)	13.9 (0.3)	15.2 (0.3)	26.8 (0.5)	33.7 (0.8)	35.5 (1.6)
Yb	123.1 (3.2)	166.0 (10.0)	272.0 (40.0)	123.0 (2.9)	103.1 (2.3)	112.4 (2.1)	162.2 (3.9)	219.5 (5.4)	227.0 (12.0)
Lu	13.6 (0.3)	21.3 (1.0)	33.4 (4.8)	21.1 (0.5)	18.6 (0.4)	19.3 (0.4)	22.9 (0.5)	31.4 (1.0)	27.9 (1.4)
∑REE + Y	2624 (11)	2890 (18)	4008 (68)	1434 (5)	1272 (5)	1370 (5)	2651 (9)	2895 (10)	3372 (20)
$(La/Lu)_{CN}$	0.11 (0.03)	0.08 (0.03)	0.05 (0.02)	0.08 (0.02)	0.10 (0.03)	0.09 (0.03)	0.07 (0.02)	0.05 (0.02)	0.07 (0.02)
$(La/Sm)_{CN}$	0.08 (0.03)	0.11 (0.04)	0.09 (0.03)	0.32 (0.10)	0.42 (0.14)	0.38 (0.13)	0.15 (0.05)	0.17 (0.06)	0.11 (0.03)
$(La/Y)_{CN}$	0.07 (0.02)	0.07 (0.03)	0.05 (0.02)	0.13 (0.04)	0.17 (0.05)	0.15 (0.05)	0.07 (0.02)	0.06 (0.02)	0.06 (0.02)
$Eu_A = Eu/Eu^*$	0.55 (0.03)	0.64 (0.03)	0.59 (0.06)	2.42 (0.12)	2.80 (0.16)	2.60 (0.15)	0.74 (0.04)	0.92 (0.05)	0.73 (0.04)
$Ce_A = Ce/Ce^*$	0.82 (0.05)	0.85 (0.05)	0.86 (0.08)	0.94 (0.05)	0.94 (0.05)	0.95 (0.05)	0.90 (0.05)	0.93 (0.05)	0.88 (0.06)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_46	UK#2_47	UK#2_48	UK#2_49	UK#2_50	UK#2_51	UK#2_52	UK#2_53	UK#2_54
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	22.6 (0.7)	19.7 (0.8)	7.4 (0.5)	16.7 (0.5)	17.5 (0.6)	15.2 (0.5)	20.3 (0.9)	21.0 (0.7)	21.0 (0.7)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	7 (10)	3 (8)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	4 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (4)	≤ LOD	≤ LOD
Zn	2 (2)	≤ LOD	2 (2)	7 (6)	≤ LOD	8 (9)	10 (9)	2 (2)	6 (4)
As	13 (5)	7 (1)	9 (1)	13 (3)	8 (0)	13 (5)	13 (4)	8 (1)	8 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	56.2 (1.3)	55.6 (1.2)	57.5 (1.3)	68.8 (1.5)	55.0 (1.1)	51.4 (1.1)	52.7 (1.4)	53.1 (1.1)	53.4 (1.0)
Y	680.0 (29.0)	489.0 (14.0)	464.0 (11.0)	841.0 (16.0)	1299.0 (27.0)	1019.0 (20.0)	693.0 (51.0)	643.0 (33.0)	752.0 (41.0)
Nb	170 (4)	136 (3)	132 (3)	241 (5)	395 (10)	273 (4)	219 (4)	184 (3)	215 (4)
Mo	15 (1)	15 (0)	14 (1)	9 (0)	14 (1)	14 (0)	16 (1)	16 (1)	15 (0)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	770000 (18000)	785000 (21000)	773000 (19000)	804000 (15000)	787000 (18000)	786000 (19000)	808000 (20000)	780000 (19000)	792000 (15000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	11.4 (0.3)	6.9 (0.2)	6.8 (0.2)	3.6 (0.1)	3.8 (0.1)	3.5 (0.1)	6.5 (0.2)	6.2 (0.2)	6.7 (0.1)
Ce	53.2 (1.2)	32.3 (0.7)	28.0 (0.6)	24.5 (0.6)	32.3 (0.7)	27.5 (0.6)	38.6 (1.1)	36.7 (1.2)	40.9 (0.9)
Pr	13.0 (0.3)	8.4 (0.2)	7.2 (0.2)	9.2 (0.2)	11.6 (0.2)	10.0 (0.2)	11.3 (0.3)	11.1 (0.4)	12.3 (0.3)
Nd	83.0 (2.2)	61.0 (1.6)	56.5 (1.1)	97.9 (3.5)	109.3 (2.1)	102.4 (2.1)	85.5 (2.2)	84.3 (3.0)	96.5 (2.2)
Sm	34.5 (1.1)	29.2 (1.0)	27.5 (0.8)	83.2 (3.8)	67.2 (1.7)	69.3 (1.5)	46.2 (1.5)	45.0 (1.6)	50.2 (1.5)
Eu	16.59 (0.48)	13.01 (0.41)	11.68 (0.36)	8.50 (0.23)	15.25 (0.47)	16.25 (0.38)	13.20 (0.39)	13.11 (0.37)	13.74 (0.34)
Gd	54.4 (1.5)	54.3 (1.6)	53.4 (1.6)	146.5 (5.7)	124.4 (2.8)	130.4 (3.0)	77.5 (3.0)	76.2 (2.8)	79.2 (2.4)
Tb	11.3 (0.4)	10.3 (0.3)	10.0 (0.3)	28.4 (0.9)	24.5 (0.6)	23.7 (0.5)	14.8 (0.7)	14.6 (0.6)	15.3 (0.5)
Dy	94.9 (3.5)	81.0 (2.2)	79.8 (2.3)	201.1 (5.0)	195.6 (3.6)	183.5 (3.8)	113.1 (5.1)	112.5 (5.1)	121.3 (5.0)
Ho	23.6 (0.9)	19.9 (0.4)	20.1 (0.5)	40.1 (1.1)	48.0 (0.9)	41.1 (1.0)	26.0 (1.3)	26.6 (1.5)	28.7 (1.5)
Er	79.7 (3.2)	64.6 (1.9)	63.7 (1.4)	108.7 (2.3)	156.4 (2.4)	123.5 (2.7)	83.0 (4.9)	82.9 (5.1)	91.4 (5.2)
Tm	12.1 (0.6)	8.7 (0.3)	8.5 (0.2)	13.9 (0.3)	21.9 (0.4)	16.1 (0.4)	11.7 (0.9)	11.6 (0.9)	13.4 (0.8)
Yb	80.2 (4.8)	50.3 (2.2)	49.3 (1.0)	75.3 (1.4)	133.7 (3.5)	88.7 (1.9)	70.4 (5.7)	70.2 (6.1)	85.7 (6.5)
Lu	12.7 (0.7)	8.4 (0.3)	8.5 (0.2)	9.6 (0.3)	21.0 (0.4)	13.0 (0.3)	10.5 (0.8)	10.6 (0.9)	13.2 (1.0)
∑REE + Y	1261 (8)	937 (5)	895 (4)	1692 (10)	2264 (7)	1868 (7)	1301 (10)	1245 (11)	1421 (11)
$(La/Lu)_{CN}$	0.09 (0.03)	0.08 (0.03)	0.08 (0.03)	0.04 (0.01)	0.02 (0.01)	0.03 (0.01)	0.06 (0.02)	0.06 (0.02)	0.05 (0.02)
$(La/Sm)_{CN}$	0.21 (0.07)	0.15 (0.05)	0.15 (0.05)	0.03 (0.01)	0.04 (0.01)	0.03 (0.01)	0.09 (0.03)	0.09 (0.03)	0.08 (0.03)
$(La/Y)_{CN}$	0.11 (0.04)	0.09 (0.03)	0.10 (0.03)	0.03 (0.01)	0.02 (0.01)	0.02 (0.01)	0.06 (0.02)	0.06 (0.02)	0.06 (0.02)
$Eu_A = Eu/Eu^*$	1.16 (0.07)	0.98 (0.06)	0.91 (0.05)	0.23 (0.02)	0.50 (0.03)	0.51 (0.02)	0.67 (0.04)	0.68 (0.04)	0.66 (0.04)
$Ce_A = Ce/Ce^*$	0.91 (0.06)	0.87 (0.06)	0.85 (0.05)	0.68 (0.04)	0.73 (0.05)	0.72 (0.05)	0.83 (0.06)	0.80 (0.06)	0.81 (0.05)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_55	UK#2_56	UK#2_57	UK#2_58	UK#2_59	UK#2_60	UK#2_61	UK#2_62	UK#2_63
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	20.2 (1.0)	17.8 (0.5)	21.7 (1.1)	28.7 (0.9)	28.3 (0.8)	28.5 (0.8)	20.5 (0.9)	18.7 (0.7)	16.0 (0.5)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (24)	≤ LOD	15 (31)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	6 (7)	8 (11)	≤ LOD	2 (2)	23 (19)	3 (3)	16 (13)
As	8 (2)	6 (0)	6 (1)	7 (1)	7 (0)	8 (1)	19 (8)	12 (4)	12 (3)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	59.8 (1.1)	59.3 (1.3)	60.0 (1.2)	60.9 (1.4)	58.7 (1.5)	58.7 (1.5)	62.2 (1.0)	55.3 (1.7)	51.6 (1.3)
Y	163.0 (2.9)	218.3 (4.6)	185.5 (3.4)	606.0 (27.0)	450.0 (17.0)	739.0 (61.0)	606.2 (9.8)	491.0 (14.0)	1084.0 (23.0)
Nb	51 (1)	83 (2)	67 (1)	110 (2)	106 (3)	98 (2)	181 (3)	76 (2)	247 (6)
Mo	10 (0)	10 (0)	10 (0)	10 (0)	10 (0)	10 (0)	10 (0)	13 (1)	14 (1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	797000 (15000)	788000 (17000)	777000 (18000)	789000 (18000)	775000 (20000)	786000 (14000)	769000 (16000)	770000 (20000)	785000 (21000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	8.5 (0.2)	9.7 (0.2)	6.2 (0.2)	17.2 (0.4)	18.1 (0.4)	19.2 (0.9)	9.6 (0.2)	6.9 (0.2)	5.1 (0.1)
Ce	35.4 (0.8)	41.8 (0.7)	31.0 (0.6)	75.3 (1.6)	76.1 (1.7)	82.8 (3.0)	46.4 (0.8)	43.7 (1.0)	43.9 (1.2)
Pr	7.3 (0.2)	8.7 (0.2)	6.9 (0.2)	17.1 (0.5)	16.8 (0.4)	19.7 (0.9)	11.1 (0.3)	13.0 (0.3)	14.6 (0.4)
Nd	46.0 (1.3)	52.6 (1.2)	45.9 (1.0)	109.8 (3.1)	103.0 (2.3)	122.0 (5.8)	78.4 (1.9)	116.7 (3.2)	121.7 (3.2)
Sm	14.5 (0.5)	17.1 (0.5)	15.6 (0.5)	46.5 (1.8)	40.7 (1.4)	49.9 (2.8)	37.2 (0.9)	50.7 (1.8)	58.2 (1.7)
Eu	6.69 (0.21)	6.94 (0.18)	6.59 (0.20)	49.00 (1.30)	47.50 (1.30)	47.20 (1.40)	8.66 (0.22)	24.74 (0.66)	22.59 (0.60)
Gd	20.1 (0.7)	23.2 (0.6)	21.0 (0.6)	72.8 (2.5)	60.8 (2.1)	75.4 (4.9)	68.9 (1.8)	75.6 (2.1)	92.8 (2.6)
Tb	3.2 (0.1)	4.1 (0.1)	3.5 (0.1)	14.3 (0.6)	11.4 (0.4)	15.6 (1.1)	13.8 (0.4)	12.2 (0.3)	17.6 (0.4)
Dy	23.4 (0.5)	31.8 (0.7)	26.7 (0.7)	117.5 (5.3)	86.6 (2.9)	122.7 (8.1)	109.2 (2.5)	87.2 (2.6)	146.6 (4.1)
Ho	5.7 (0.2)	7.8 (0.2)	6.6 (0.2)	26.4 (1.3)	20.0 (0.8)	28.8 (2.1)	24.5 (0.5)	19.0 (0.5)	35.6 (0.8)
Er	18.8 (0.5)	25.5 (0.6)	22.0 (0.5)	86.6 (5.0)	60.3 (2.2)	90.5 (5.7)	71.8 (1.4)	57.8 (1.6)	118.1 (2.1)
Tm	2.5 (0.1)	3.6 (0.1)	3.1 (0.1)	13.7 (1.1)	8.3 (0.4)	14.1 (0.9)	9.2 (0.2)	7.4 (0.2)	17.9 (0.4)
Yb	16.0 (0.6)	22.1 (0.6)	21.5 (0.5)	89.7 (7.7)	48.4 (2.3)	96.6 (6.9)	50.5 (1.1)	41.1 (1.4)	109.8 (2.4)
Lu	2.9 (0.1)	3.8 (0.1)	3.9 (0.1)	14.1 (1.2)	8.1 (0.4)	14.6 (1.1)	7.1 (0.2)	6.9 (0.3)	16.7 (0.4)
∑REE + Y	374 (2)	477 (2)	406 (2)	1356 (12)	1056 (6)	1538 (15)	1153 (4)	1054 (6)	1905 (7)
$(La/Lu)_{CN}$	0.30 (0.10)	0.27 (0.09)	0.16 (0.05)	0.13 (0.05)	0.23 (0.08)	0.14 (0.05)	0.14 (0.05)	0.10 (0.04)	0.03 (0.01)
$(La/Sm)_{CN}$	0.36 (0.12)	0.36 (0.12)	0.25 (0.08)	0.23 (0.08)	0.28 (0.09)	0.24 (0.09)	0.16 (0.05)	0.08 (0.03)	0.06 (0.02)
$(La/Y)_{CN}$	0.34 (0.11)	0.30 (0.09)	0.22 (0.07)	0.19 (0.07)	0.27 (0.09)	0.17 (0.07)	0.10 (0.03)	0.09 (0.03)	0.03 (0.01)
$Eu_A = Eu/Eu^*$	1.19 (0.08)	1.06 (0.06)	1.11 (0.06)	2.55 (0.16)	2.90 (0.18)	2.33 (0.22)	0.51 (0.03)	1.21 (0.07)	0.93 (0.05)
$Ce_A = Ce/Ce^*$	0.99 (0.06)	0.99 (0.05)	0.99 (0.06)	0.94 (0.06)	0.95 (0.06)	0.91 (0.08)	0.93 (0.06)	0.83 (0.05)	0.78 (0.06)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_64	UK#2_65	UK#2_66	UK#2_67	UK#2_68	UK#2_69	UK#2_70	UK#2_71	UK#2_72
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	20.0 (1.1)	25.5 (0.6)	27.1 (0.9)	25.0 (0.8)	23.8 (0.7)	23.8 (0.6)	23.3 (0.7)	30.5 (1.5)	20.5 (1.7)
Fe	≤ LOD	14 (38)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	28 (29)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	5 (5)	3 (3)	≤ LOD	3 (3)	6 (6)	≤ LOD	≤ LOD
As	9 (3)	9 (1)	10 (2)	14 (5)	9 (1)	21 (12)	13 (4)	9 (1)	9 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	62.3 (1.4)	58.2 (1.0)	57.0 (1.4)	51.7 (1.3)	50.3 (1.2)	51.0 (1.3)	61.7 (1.3)	61.4 (1.1)	62.9 (1.8)
Y	302.0 (6.3)	1441.0 (26.0)	1701.0 (40.0)	1447.0 (33.0)	1219.0 (58.0)	1098.0 (26.0)	1127.0 (21.0)	2480.0 (160.0)	799.0 (39.0)
Nb	185 (11)	356 (6)	556 (10)	357 (10)	279 (20)	268 (6)	567 (8)	522 (9)	168 (5)
Mo	9 (1)	11 (0)	11 (1)	14 (1)	14 (0)	14 (1)	12 (0)	11 (0)	12 (1)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	776000 (21000)	796000 (14000)	796000 (19000)	781000 (21000)	781000 (16000)	774000 (18000)	780000 (19000)	768000 (18000)	775000 (18000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (0)
La	4.1 (0.4)	7.2 (0.2)	8.3 (0.2)	7.6 (0.2)	7.4 (0.2)	7.1 (0.2)	18.2 (0.4)	19.7 (0.3)	14.1 (0.8)
Ce	24.0 (2.0)	43.9 (0.7)	48.8 (1.2)	51.2 (1.3)	52.9 (1.4)	49.0 (1.0)	74.2 (2.0)	81.5 (2.0)	56.1 (2.7)
Pr	7.5 (0.4)	14.0 (0.3)	14.1 (0.4)	16.5 (0.5)	17.0 (0.6)	15.6 (0.4)	16.7 (0.5)	19.0 (0.5)	12.5 (0.7)
Nd	65.9 (2.1)	123.7 (2.6)	116.8 (3.0)	158.9 (4.8)	150.5 (5.6)	140.3 (3.6)	114.7 (2.9)	135.1 (3.0)	78.8 (4.2)
Sm	44.1 (1.9)	92.4 (1.9)	80.6 (2.2)	98.9 (2.8)	80.9 (3.2)	74.4 (1.9)	64.6 (1.7)	89.2 (2.3)	40.4 (1.9)
Eu	8.44 (0.23)	13.02 (0.28)	11.48 (0.34)	23.44 (0.70)	22.22 (0.55)	21.64 (0.67)	37.51 (0.96)	45.20 (1.10)	59.40 (1.90)
Gd	71.9 (3.5)	207.9 (4.1)	185.4 (5.1)	176.7 (5.3)	144.6 (5.6)	136.4 (3.7)	134.1 (3.3)	176.7 (5.1)	60.4 (2.4)
Tb	13.3 (0.7)	44.2 (0.9)	41.7 (1.0)	31.6 (0.9)	25.1 (0.9)	23.9 (0.7)	27.3 (0.6)	41.8 (1.5)	13.5 (0.5)
Dy	88.3 (3.8)	349.9 (7.7)	347.8 (6.5)	241.1 (6.9)	197.6 (7.1)	180.0 (4.1)	227.3 (4.4)	359.0 (16.0)	115.1 (4.5)
Ho	16.1 (0.6)	73.2 (1.8)	78.9 (1.8)	55.9 (1.4)	46.5 (1.7)	42.1 (0.9)	53.8 (0.9)	84.3 (3.9)	25.8 (1.1)
Er	40.2 (1.2)	206.0 (4.4)	232.2 (5.3)	173.5 (4.3)	144.0 (5.5)	129.1 (2.9)	161.5 (3.1)	288.0 (17.0)	86.8 (4.2)
Tm	4.4 (0.1)	26.8 (0.7)	29.3 (0.7)	23.8 (0.6)	19.8 (0.9)	16.8 (0.3)	19.6 (0.5)	49.6 (3.4)	15.0 (1.0)
Yb	20.5 (0.9)	142.9 (3.6)	153.6 (3.7)	140.3 (3.8)	121.5 (7.4)	100.0 (2.3)	99.3 (3.3)	355.0 (29.0)	111.2 (9.7)
Lu	2.7 (0.2)	16.8 (0.4)	19.7 (0.4)	21.1 (0.6)	19.8 (1.1)	16.1 (0.4)	14.6 (0.5)	49.8 (4.1)	17.0 (1.4)
∑REE + Y	713 (6)	2803 (11)	3070 (11)	2668 (12)	2269 (15)	2050 (8)	2190 (8)	4274 (38)	1505 (13)
$(La/Lu)_{CN}$	0.16 (0.06)	0.04 (0.01)	0.04 (0.01)	0.04 (0.01)	0.04 (0.01)	0.05 (0.01)	0.13 (0.04)	0.04 (0.02)	0.09 (0.03)
$(La/Sm)_{CN}$	0.06 (0.02)	0.05 (0.02)	0.06 (0.02)	0.05 (0.02)	0.06 (0.02)	0.06 (0.02)	0.18 (0.06)	0.14 (0.04)	0.22 (0.08)
$(La/Y)_{CN}$	0.09 (0.03)	0.03 (0.01)	0.03 (0.01)	0.04 (0.01)	0.04 (0.01)	0.04 (0.01)	0.11 (0.03)	0.05 (0.02)	0.12 (0.04)
$Eu_A = Eu/Eu^*$	0.45 (0.03)	0.28 (0.01)	0.27 (0.02)	0.53 (0.03)	0.62 (0.04)	0.64 (0.04)	1.19 (0.06)	1.07 (0.06)	3.65 (0.27)
$Ce_A = Ce/Ce^*$	0.78 (0.10)	0.78 (0.04)	0.84 (0.06)	0.78 (0.06)	0.79 (0.06)	0.79 (0.05)	0.93 (0.06)	0.91 (0.06)	0.93 (0.10)

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TABLE E2. *(continued)*

Sample (ppm)	UK#2_73	UK#2_74	UK#2_75
Li	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD
Mn	26.8 (1.1)	27.1 (0.7)	27.6 (0.8)
Fe	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD
Zn	19 (13)	3 (2)	≤ LOD
As	28 (13)	18 (16)	14 (6)
Rb	≤ LOD	≤ LOD	≤ LOD
Sr	61.2 (1.2)	56.0 (1.1)	55.3 (1.1)
Y	686.0 (32.0)	665.0 (14.0)	460.4 (9.1)
Nb	214 (4)	301 (6)	196 (4)
Mo	12 (0)	13 (1)	12 (0)
Ag	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD
W	772000 (18000)	778000 (16000)	755000 (17000)
Th	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD
La	10.5 (1.8)	10.6 (0.2)	8.1 (0.2)
Ce	47.4 (4.1)	49.3 (0.8)	38.6 (0.9)
Pr	12.1 (0.7)	12.5 (0.2)	9.4 (0.3)
Nd	81.3 (3.2)	86.1 (1.7)	61.8 (1.4)
Sm	40.6 (1.5)	44.2 (1.2)	29.2 (0.7)
Eu	17.61 (0.43)	15.15 (0.43)	13.78 (0.39)
Gd	68.3 (2.2)	85.4 (2.2)	54.7 (1.4)
Tb	14.8 (0.5)	17.1 (0.4)	11.2 (0.3)
Dy	123.5 (3.5)	138.0 (3.0)	90.9 (1.9)
Ho	28.4 (0.8)	31.7 (0.7)	21.6 (0.4)
Er	90.9 (2.8)	92.7 (1.6)	66.2 (1.3)
Tm	12.7 (0.6)	11.2 (0.3)	8.0 (0.2)
Yb	74.6 (4.4)	56.4 (1.6)	37.8 (1.0)
Lu	11.6 (0.5)	8.2 (0.2)	6.5 (0.2)
∑REE + Y	1320 (9)	1324 (5)	918 (3)
$(La/Lu)_{CN}$	0.09 (0.03)	0.13 (0.04)	0.13 (0.04)
$(La/Sm)_{CN}$	0.16 (0.06)	0.15 (0.05)	0.17 (0.06)
$(La/Y)_{CN}$	0.10 (0.04)	0.11 (0.03)	0.12 (0.04)
Eu_A = Eu/Eu*	1.01 (0.06)	0.74 (0.04)	1.03 (0.05)
Ce_A = Ce/Ce*	0.87 (0.13)	0.88 (0.05)	0.91 (0.06)

TABLE E3. Major and trace element compositions of scheelite from UK #3 (MPB-13-003).

Sample (ppm)	UK#3_1	UK#3_2	UK#3_3	UK#3_4
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	16.0 (0.6)	12.0 (0.5)	10.6 (0.4)	15.6 (0.6)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	5 (5)	≤ LOD	3 (4)	≤ LOD
As	19 (1)	16 (1)	18 (1)	20 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	202.2 (4.2)	189.5 (3.7)	217.5 (3.7)	213.3 (4.9)
Y	90.5 (1.6)	90.1 (2.0)	81.1 (1.4)	96.2 (2.2)
Nb	105 (2)	125 (3)	119 (2)	149 (3)
Mo	2689 (48)	2706 (52)	2391 (37)	2310 (49)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	750000 (18000)	758000 (18000)	754000 (16000)	758000 (20000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	5.7 (0.2)	5.2 (0.2)	7.9 (0.2)	10.0 (0.2)
Ce	25.0 (0.6)	23.7 (0.7)	31.5 (0.6)	37.8 (0.9)
Pr	4.8 (0.1)	4.7 (0.2)	5.8 (0.1)	6.8 (0.2)
Nd	29.5 (0.8)	31.6 (0.8)	35.6 (0.8)	38.9 (0.9)
Sm	9.5 (0.3)	11.1 (0.4)	11.4 (0.3)	12.0 (0.4)
Eu	3.25 (0.11)	3.47 (0.13)	3.29 (0.11)	3.75 (0.14)
Gd	13.3 (0.4)	15.4 (0.5)	14.8 (0.4)	14.5 (0.6)
Tb	2.1 (0.1)	2.4 (0.1)	2.3 (0.1)	2.3 (0.1)
Dy	15.2 (0.4)	16.8 (0.5)	15.5 (0.5)	16.2 (0.5)
Ho	3.5 (0.1)	3.8 (0.1)	3.6 (0.1)	3.7 (0.1)
Er	11.1 (0.4)	10.9 (0.2)	10.1 (0.3)	11.4 (0.3)
Tm	1.5 (0.1)	1.4 (0.1)	1.3 (0.1)	1.6 (0.1)
Yb	8.1 (0.3)	8.0 (0.3)	7.5 (0.2)	9.9 (0.3)
Lu	1.1 (0.0)	1.1 (0.0)	1.0 (0.0)	1.4 (0.1)
∑REE + Y	224 (1)	230 (1)	233 (1)	266 (2)
$(La/Lu)_{CN}$	0.56 (0.15)	0.50 (0.14)	0.82 (0.20)	0.75 (0.19)
$(La/Sm)_{CN}$	0.37 (0.10)	0.29 (0.08)	0.43 (0.10)	0.52 (0.12)
$(La/Y)_{CN}$	0.42 (0.09)	0.38 (0.09)	0.65 (0.13)	0.69 (0.14)
Eu_A = Eu/Eu*	0.88 (0.05)	0.81 (0.05)	0.77 (0.04)	0.86 (0.06)
Ce_A = Ce/Ce*	1.07 (0.07)	1.05 (0.07)	1.06 (0.06)	1.06 (0.06)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_5	UK#3_6	UK#3_7	UK#3_8	UK#3_9	UK#3_10	UK#3_11	UK#3_12	UK#3_13
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	15.1 (0.5)	15.4 (0.5)	14.0 (1.2)	15.7 (0.5)	16.0 (0.7)	12.6 (0.5)	13.0 (0.7)	13.8 (0.5)	14.0 (0.6)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	16 (45)	32 (54)	≤ LOD	40 (88)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	4 (6)	15 (19)	≤ LOD	11 (13)	34 (28)	14 (18)	8 (10)
As	17 (1)	20 (1)	18 (1)	23 (1)	22 (1)	14 (1)	14 (1)	17 (1)	28 (19)
Rb	≤ LOD	≤ LOD	0.8 (0.2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	208.8 (5.1)	234.4 (6.0)	203.0 (3.6)	236.3 (5.0)	238.6 (4.2)	187.2 (3.1)	185.4 (2.8)	206.9 (4.1)	195.1 (3.3)
Y	97.5 (2.2)	65.8 (1.7)	88.3 (1.3)	98.7 (1.6)	91.9 (1.5)	94.1 (1.4)	90.3 (1.8)	84.0 (1.4)	91.6 (1.7)
Nb	142 (3)	64 (2)	119 (5)	122 (2)	131 (2)	118 (2)	105 (2)	104 (2)	120 (2)
Mo	2474 (50)	2754 (55)	2424 (39)	2777 (53)	2384 (46)	1349 (27)	2190 (44)	2813 (40)	2198 (43)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	746000 (17000)	745000 (17000)	750000 (16000)	743000 (13000)	760000 (17000)	746000 (14000)	764000 (14000)	750000 (18000)	775000 (17000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	7.6 (0.2)	9.7 (0.2)	7.4 (0.1)	12.1 (0.3)	12.6 (0.3)	1.7 (0.1)	1.5 (0.1)	6.3 (0.1)	3.9 (0.1)
Ce	29.4 (0.6)	27.1 (0.6)	26.0 (0.4)	38.3 (0.8)	42.9 (0.9)	9.4 (0.2)	7.5 (0.3)	22.4 (0.5)	17.8 (0.3)
Pr	5.2 (0.1)	3.7 (0.1)	4.3 (0.1)	6.1 (0.2)	7.0 (0.2)	2.2 (0.1)	1.6 (0.1)	3.8 (0.1)	3.7 (0.1)
Nd	31.6 (0.9)	17.1 (0.5)	23.8 (0.6)	32.3 (0.7)	40.2 (0.8)	16.9 (0.4)	11.6 (0.4)	20.8 (0.5)	24.2 (0.6)
Sm	10.8 (0.5)	4.4 (0.2)	7.1 (0.3)	9.8 (0.3)	11.8 (0.4)	7.2 (0.3)	5.3 (0.2)	6.8 (0.3)	8.9 (0.3)
Eu	3.65 (0.13)	1.69 (0.08)	2.55 (0.09)	3.02 (0.10)	3.46 (0.09)	2.49 (0.09)	1.95 (0.07)	2.34 (0.07)	2.95 (0.11)
Gd	14.0 (0.4)	5.7 (0.3)	10.1 (0.4)	12.4 (0.4)	15.6 (0.5)	11.9 (0.4)	9.6 (0.3)	9.2 (0.4)	12.4 (0.4)
Tb	2.4 (0.1)	1.1 (0.0)	1.7 (0.1)	2.0 (0.1)	2.2 (0.1)	2.2 (0.1)	1.8 (0.1)	1.6 (0.1)	2.2 (0.1)
Dy	16.6 (0.5)	7.8 (0.3)	12.8 (0.3)	14.8 (0.4)	15.8 (0.4)	16.5 (0.4)	14.5 (0.3)	12.3 (0.3)	15.9 (0.4)
Ho	3.8 (0.1)	2.0 (0.1)	3.1 (0.1)	3.4 (0.1)	3.6 (0.1)	3.8 (0.1)	3.7 (0.1)	3.0 (0.1)	3.8 (0.1)
Er	11.8 (0.4)	7.3 (0.2)	10.3 (0.3)	11.4 (0.3)	11.2 (0.3)	12.2 (0.3)	11.7 (0.3)	9.8 (0.3)	11.5 (0.3)
Tm	1.7 (0.0)	1.2 (0.0)	1.6 (0.1)	1.7 (0.1)	1.6 (0.0)	1.7 (0.1)	1.7 (0.1)	1.6 (0.1)	1.6 (0.1)
Yb	10.2 (0.3)	8.5 (0.3)	9.6 (0.2)	11.2 (0.3)	9.7 (0.3)	9.9 (0.3)	10.4 (0.4)	9.7 (0.3)	9.4 (0.3)
Lu	1.4 (0.1)	1.2 (0.0)	1.4 (0.1)	1.6 (0.1)	1.4 (0.1)	1.4 (0.0)	1.4 (0.1)	1.4 (0.0)	1.3 (0.0)
∑REE + Y	247 (1)	164 (1)	210 (1)	259 (1)	271 (2)	194 (1)	175 (1)	195 (1)	211 (1)
$(La/Lu)_{CN}$	0.57 (0.14)	0.82 (0.19)	0.53 (0.13)	0.77 (0.18)	0.92 (0.24)	0.12 (0.03)	0.11 (0.03)	0.47 (0.11)	0.31 (0.08)
$(La/Sm)_{CN}$	0.44 (0.11)	1.39 (0.34)	0.66 (0.17)	0.78 (0.17)	0.67 (0.16)	0.15 (0.04)	0.18 (0.05)	0.58 (0.14)	0.27 (0.07)
$(La/Y)_{CN}$	0.52 (0.11)	0.98 (0.21)	0.56 (0.10)	0.81 (0.16)	0.91 (0.17)	0.12 (0.03)	0.11 (0.03)	0.50 (0.10)	0.28 (0.06)
$Eu_A = Eu/Eu^*$	0.90 (0.06)	1.03 (0.09)	0.92 (0.07)	0.84 (0.05)	0.77 (0.05)	0.81 (0.06)	0.82 (0.06)	0.90 (0.06)	0.85 (0.06)
$Ce_A = Ce/Ce^*$	1.07 (0.06)	1.08 (0.06)	1.08 (0.06)	1.07 (0.06)	1.08 (0.06)	0.99 (0.07)	1.00 (0.09)	1.07 (0.06)	1.02 (0.06)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_14	UK#3_15	UK#3_16	UK#3_17	UK#3_18	UK#3_19	UK#3_20	UK#3_21	UK#3_22
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	13.5 (0.6)	15.0 (0.5)	14.2 (0.6)	15.5 (0.6)	17.1 (0.7)	14.9 (0.6)	13.7 (0.8)	13.1 (0.5)	13.0 (0.6)
Fe	≤ LOD	12 (37)	7 (12)	≤ LOD	≤ LOD	4 (9)	≤ LOD	≤ LOD	54 (80)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2)
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (5)	4 (5)	≤ LOD	24 (19)
Zn	5 (6)	≤ LOD	7 (7)	3 (4)	15 (14)	2 (3)	210 (340)	3 (3)	37 (38)
As	16 (1)	17 (1)	15 (1)	20 (1)	21 (3)	31 (9)	25 (5)	24 (5)	200 (350)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	200.2 (4.1)	225.5 (3.9)	209.0 (3.9)	230.7 (3.8)	224.8 (4.1)	193.2 (3.2)	185.2 (3.1)	183.4 (3.2)	185.9 (2.6)
Y	89.1 (1.6)	86.2 (1.4)	127.5 (2.0)	106.8 (2.0)	88.9 (1.3)	103.8 (1.6)	104.8 (1.5)	104.7 (2.2)	80.7 (1.1)
Nb	116 (2)	153 (2)	200 (4)	149 (2)	111 (1)	138 (2)	136 (2)	133 (3)	99 (1)
Mo	2130 (38)	2261 (36)	1922 (33)	2767 (60)	2857 (59)	2392 (40)	2431 (35)	2516 (56)	2694 (45)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	762000 (17000)	746000 (12000)	748000 (17000)	755000 (14000)	754000 (18000)	755000 (12000)	759000 (13000)	751000 (15000)	755000 (12000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	4.2 (0.1)	13.6 (0.3)	5.9 (0.2)	8.8 (0.2)	7.6 (0.2)	6.1 (0.2)	4.7 (0.3)	3.8 (0.1)	4.1 (0.1)
Ce	19.1 (0.4)	49.3 (0.7)	26.8 (0.6)	31.8 (0.8)	26.5 (0.7)	26.4 (0.4)	21.9 (1.2)	18.5 (0.4)	17.8 (0.4)
Pr	3.9 (0.1)	8.0 (0.2)	5.6 (0.1)	5.6 (0.1)	4.5 (0.1)	5.2 (0.1)	4.6 (0.2)	4.0 (0.1)	3.6 (0.1)
Nd	26.2 (0.7)	42.6 (0.9)	40.7 (1.0)	32.5 (0.8)	25.4 (0.6)	32.4 (0.8)	31.0 (1.1)	27.1 (0.6)	23.5 (0.6)
Sm	9.3 (0.5)	11.3 (0.4)	16.8 (0.4)	11.1 (0.3)	7.9 (0.4)	11.5 (0.3)	11.9 (0.4)	11.0 (0.4)	8.8 (0.3)
Eu	3.03 (0.10)	3.80 (0.13)	4.95 (0.15)	3.57 (0.09)	2.69 (0.10)	3.61 (0.11)	3.85 (0.09)	3.72 (0.11)	2.78 (0.09)
Gd	13.5 (0.5)	13.2 (0.4)	24.5 (0.6)	14.9 (0.5)	10.7 (0.4)	15.8 (0.5)	17.3 (0.5)	16.4 (0.5)	13.0 (0.4)
Tb	2.3 (0.1)	2.2 (0.1)	3.7 (0.1)	2.5 (0.1)	1.8 (0.1)	2.6 (0.1)	2.7 (0.1)	2.7 (0.1)	2.1 (0.1)
Dy	16.0 (0.4)	15.7 (0.4)	26.3 (0.5)	18.3 (0.5)	13.4 (0.4)	18.3 (0.5)	20.0 (0.5)	19.7 (0.5)	14.8 (0.4)
Ho	3.6 (0.1)	3.4 (0.1)	5.6 (0.1)	4.2 (0.1)	3.3 (0.1)	4.2 (0.1)	4.5 (0.1)	4.4 (0.1)	3.4 (0.1)
Er	11.3 (0.3)	10.4 (0.3)	16.1 (0.4)	12.9 (0.3)	10.6 (0.3)	12.8 (0.3)	13.5 (0.3)	13.5 (0.3)	10.4 (0.2)
Tm	1.6 (0.1)	1.5 (0.0)	2.1 (0.1)	1.9 (0.1)	1.6 (0.1)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	1.3 (0.0)
Yb	9.0 (0.3)	8.6 (0.3)	11.9 (0.3)	11.6 (0.3)	9.0 (0.3)	9.6 (0.3)	9.8 (0.3)	9.6 (0.3)	7.2 (0.2)
Lu	1.2 (0.0)	1.2 (0.0)	1.6 (0.1)	1.6 (0.1)	1.4 (0.1)	1.3 (0.0)	1.3 (0.0)	1.3 (0.0)	1.0 (0.0)
∑REE + Y	213 (1)	271 (1)	320 (2)	268 (1)	215 (1)	255 (1)	254 (2)	242 (1)	194 (1)
$(La/Lu)_{CN}$	0.36 (0.10)	1.20 (0.30)	0.38 (0.10)	0.56 (0.14)	0.58 (0.15)	0.49 (0.12)	0.37 (0.12)	0.31 (0.08)	0.43 (0.11)
$(La/Sm)_{CN}$	0.28 (0.08)	0.75 (0.17)	0.22 (0.05)	0.50 (0.11)	0.61 (0.17)	0.33 (0.08)	0.25 (0.08)	0.22 (0.05)	0.29 (0.07)
$(La/Y)_{CN}$	0.31 (0.07)	1.05 (0.21)	0.31 (0.07)	0.55 (0.11)	0.57 (0.11)	0.39 (0.08)	0.30 (0.08)	0.24 (0.05)	0.33 (0.07)
$Eu_A = Eu/Eu^*$	0.82 (0.06)	0.94 (0.06)	0.74 (0.04)	0.84 (0.05)	0.89 (0.07)	0.81 (0.05)	0.81 (0.04)	0.84 (0.05)	0.79 (0.05)
$Ce_A = Ce/Ce^*$	1.03 (0.07)	1.11 (0.06)	1.00 (0.06)	1.06 (0.06)	1.06 (0.06)	1.04 (0.06)	1.02 (0.10)	1.01 (0.06)	1.03 (0.06)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_23	UK#3_24	UK#3_25	UK#3_26	UK#3_27	UK#3_28	UK#3_29	UK#3_30	UK#3_31
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	17.9 (3.6)	14.3 (0.5)	18.7 (1.0)	15.1 (0.6)	16.1 (0.6)	18.8 (2.3)	16.5 (0.7)	17.0 (0.7)	16.1 (0.5)
Fe	10 (10)	22 (54)	340 (280)	≤ LOD	≤ LOD	180 (180)	11 (10)	10 (28)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (5)	≤ LOD	≤ LOD	≤ LOD
Cu	14 (12)	≤ LOD	36 (26)	90 (160)	≤ LOD	16 (11)	≤ LOD	8 (12)	≤ LOD
Zn	18 (14)	15 (22)	210 (340)	15 (16)	11 (13)	51 (54)	160 (280)	6 (9)	2 (3)
As	36 (9)	24 (3)	82 (41)	26 (7)	28 (4)	59 (26)	19 (3)	24 (3)	20 (4)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	244.8 (3.5)	208.1 (3.8)	237.0 (3.6)	238.3 (4.2)	245.1 (5.3)	205.5 (4.5)	194.5 (4.1)	199.3 (5.1)	219.4 (3.4)
Y	109.7 (1.7)	107.9 (2.0)	126.7 (1.9)	118.0 (2.3)	109.9 (1.8)	96.0 (2.3)	86.0 (1.6)	112.8 (2.6)	90.5 (1.2)
Nb	143 (2)	149 (3)	174 (3)	154 (3)	122 (2)	129 (3)	108 (2)	150 (3)	135 (2)
Mo	2341 (52)	2382 (44)	3077 (55)	2968 (53)	2911 (56)	2701 (55)	2743 (47)	2505 (45)	2379 (36)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.1 (0.9)	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	760000 (12000)	772000 (18000)	768000 (14000)	755000 (14000)	761000 (15000)	744000 (19000)	748000 (15000)	746000 (17000)	755000 (14000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	11.1 (0.2)	7.3 (0.1)	12.6 (0.2)	10.9 (0.2)	10.9 (0.3)	5.9 (0.2)	5.7 (0.2)	9.5 (0.2)	8.1 (0.2)
Ce	46.8 (0.9)	32.6 (0.6)	42.4 (0.8)	38.9 (0.7)	35.8 (0.7)	24.0 (0.6)	23.4 (0.6)	36.2 (0.7)	31.8 (0.7)
Pr	8.5 (0.2)	6.5 (0.2)	6.9 (0.1)	6.2 (0.2)	5.6 (0.1)	4.5 (0.1)	4.1 (0.1)	6.5 (0.2)	6.0 (0.1)
Nd	49.1 (1.2)	41.9 (1.1)	36.4 (0.9)	32.6 (0.7)	29.9 (0.7)	26.4 (0.6)	23.4 (0.8)	36.9 (1.0)	36.1 (0.9)
Sm	14.7 (0.4)	14.0 (0.5)	10.9 (0.4)	9.8 (0.4)	8.9 (0.3)	9.7 (0.3)	7.7 (0.3)	12.9 (0.4)	13.2 (0.4)
Eu	4.84 (0.13)	4.40 (0.14)	3.70 (0.11)	3.28 (0.11)	3.02 (0.08)	3.35 (0.10)	2.65 (0.09)	4.39 (0.15)	4.26 (0.10)
Gd	18.3 (0.6)	18.9 (0.6)	14.1 (0.4)	12.5 (0.4)	11.4 (0.4)	13.0 (0.5)	10.9 (0.5)	17.5 (0.5)	17.0 (0.5)
Tb	2.9 (0.1)	3.0 (0.1)	2.4 (0.1)	2.2 (0.1)	1.9 (0.1)	2.2 (0.1)	1.8 (0.1)	2.8 (0.1)	2.8 (0.1)
Dy	20.3 (0.5)	21.1 (0.6)	18.9 (0.5)	16.5 (0.4)	15.1 (0.4)	15.8 (0.5)	13.5 (0.4)	20.0 (0.6)	19.4 (0.5)
Ho	4.6 (0.1)	4.7 (0.1)	4.3 (0.1)	4.0 (0.1)	3.7 (0.1)	3.7 (0.1)	3.1 (0.1)	4.4 (0.1)	4.0 (0.1)
Er	13.1 (0.3)	13.9 (0.4)	14.8 (0.3)	13.8 (0.3)	13.0 (0.3)	11.9 (0.3)	10.3 (0.3)	13.5 (0.3)	11.2 (0.2)
Tm	1.7 (0.1)	1.7 (0.1)	2.3 (0.1)	2.2 (0.1)	2.0 (0.1)	1.7 (0.1)	1.6 (0.0)	1.9 (0.1)	1.4 (0.0)
Yb	8.5 (0.3)	9.1 (0.4)	14.8 (0.4)	13.5 (0.4)	12.6 (0.4)	10.2 (0.2)	8.9 (0.3)	11.0 (0.3)	7.8 (0.2)
Lu	1.0 (0.0)	1.2 (0.0)	2.1 (0.1)	2.0 (0.1)	1.9 (0.1)	1.4 (0.0)	1.2 (0.0)	1.5 (0.1)	1.0 (0.0)
∑REE + Y	315 (2)	288 (2)	313 (1)	286 (1)	265 (1)	230 (1)	204 (1)	292 (2)	255 (1)
$(La/Lu)_{CN}$	1.13 (0.26)	0.65 (0.16)	0.62 (0.14)	0.57 (0.13)	0.59 (0.13)	0.43 (0.10)	0.50 (0.13)	0.67 (0.16)	0.84 (0.21)
$(La/Sm)_{CN}$	0.47 (0.10)	0.33 (0.08)	0.72 (0.16)	0.69 (0.17)	0.77 (0.18)	0.38 (0.10)	0.47 (0.12)	0.46 (0.11)	0.38 (0.09)
$(La/Y)_{CN}$	0.67 (0.12)	0.45 (0.09)	0.66 (0.12)	0.61 (0.12)	0.66 (0.13)	0.41 (0.09)	0.44 (0.10)	0.56 (0.12)	0.59 (0.11)
Eu_A = Eu/Eu*	0.90 (0.05)	0.82 (0.05)	0.91 (0.05)	0.90 (0.06)	0.91 (0.05)	0.91 (0.06)	0.88 (0.06)	0.89 (0.05)	0.86 (0.05)
Ce_A = Ce/Ce*	1.08 (0.06)	1.04 (0.06)	1.07 (0.05)	1.12 (0.06)	1.09 (0.06)	1.05 (0.07)	1.10 (0.07)	1.06 (0.06)	1.04 (0.06)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_32	UK#3_33	UK#3_34	UK#3_35	UK#3_36	UK#3_37	UK#3_38	UK#3_39	UK#3_40
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	13.7 (0.4)	16.8 (0.6)	16.1 (0.8)	14.4 (0.5)	14.6 (0.5)	16.5 (0.6)	13.0 (0.5)	17.4 (0.6)	16.2 (0.5)
Fe	≤ LOD	≤ LOD	233 (67)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	252 (12)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (4)	≤ LOD	≤ LOD	3 (5)
Zn	≤ LOD	≤ LOD	2 (1)	4 (4)	≤ LOD	2 (2)	≤ LOD	≤ LOD	210 (410)
As	18 (1)	15 (1)	15 (1)	17 (2)	20 (2)	33 (6)	22 (1)	22 (1)	19 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	220.3 (5.1)	223.3 (4.4)	208.1 (3.7)	247.0 (4.1)	276.7 (5.1)	242.3 (3.9)	218.8 (4.6)	204.4 (3.9)	240.9 (4.2)
Y	96.0 (1.9)	97.3 (1.7)	99.4 (1.5)	73.5 (1.3)	105.3 (1.9)	87.4 (1.5)	91.2 (1.6)	71.6 (1.4)	76.7 (1.3)
Nb	153 (3)	157 (2)	155 (2)	139 (2)	153 (3)	98 (1)	115 (2)	68 (1)	85 (2)
Mo	2200 (45)	2105 (57)	2125 (34)	2158 (35)	2753 (53)	2373 (36)	2355 (42)	2511 (47)	2445 (57)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	770000 (22000)	754000 (14000)	770000 (16000)	747000 (12000)	766000 (15000)	757000 (13000)	762000 (15000)	750000 (15000)	765000 (14000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	10.0 (0.3)	8.8 (0.2)	9.1 (0.4)	16.0 (0.3)	17.9 (0.3)	17.2 (0.4)	13.2 (0.3)	9.8 (0.2)	8.6 (0.2)
Ce	39.8 (0.9)	36.5 (0.7)	31.5 (0.8)	51.9 (0.7)	53.8 (1.0)	57.3 (1.0)	47.3 (1.2)	31.0 (0.6)	26.0 (0.4)
Pr	7.3 (0.2)	7.1 (0.2)	5.9 (0.2)	8.3 (0.2)	7.9 (0.2)	8.5 (0.2)	7.7 (0.2)	5.3 (0.1)	3.8 (0.1)
Nd	43.2 (1.1)	43.0 (0.9)	33.6 (1.0)	42.2 (0.8)	36.8 (0.8)	40.2 (0.8)	41.0 (1.0)	29.8 (0.8)	17.7 (0.5)
Sm	14.3 (0.4)	14.4 (0.4)	11.5 (0.4)	11.1 (0.4)	8.6 (0.3)	8.9 (0.4)	10.0 (0.3)	8.3 (0.3)	4.8 (0.2)
Eu	4.46 (0.13)	4.25 (0.12)	3.97 (0.14)	3.31 (0.11)	2.92 (0.09)	2.75 (0.10)	3.00 (0.07)	2.49 (0.09)	1.90 (0.08)
Gd	18.5 (0.6)	18.8 (0.5)	15.7 (0.5)	11.7 (0.4)	9.7 (0.4)	10.0 (0.4)	11.9 (0.4)	10.3 (0.4)	6.5 (0.3)
Tb	2.9 (0.1)	2.9 (0.1)	2.6 (0.1)	1.8 (0.1)	1.6 (0.0)	1.6 (0.1)	1.9 (0.1)	1.7 (0.1)	1.2 (0.1)
Dy	19.9 (0.5)	20.3 (0.5)	19.0 (0.5)	12.8 (0.3)	12.8 (0.3)	12.4 (0.4)	14.0 (0.4)	12.0 (0.5)	9.5 (0.3)
Ho	4.2 (0.1)	4.3 (0.1)	4.2 (0.1)	2.8 (0.1)	3.2 (0.1)	3.1 (0.1)	3.4 (0.1)	2.7 (0.1)	2.4 (0.1)
Er	12.3 (0.3)	12.5 (0.3)	12.7 (0.4)	8.7 (0.2)	12.2 (0.3)	10.4 (0.3)	11.0 (0.3)	8.7 (0.3)	8.6 (0.2)
Tm	1.6 (0.1)	1.6 (0.1)	1.8 (0.1)	1.3 (0.1)	2.0 (0.1)	1.5 (0.1)	1.6 (0.1)	1.2 (0.0)	1.4 (0.1)
Yb	8.4 (0.3)	8.9 (0.3)	10.1 (0.2)	8.4 (0.3)	13.5 (0.3)	8.9 (0.2)	9.0 (0.3)	6.7 (0.2)	9.5 (0.3)
Lu	1.1 (0.0)	1.2 (0.1)	1.4 (0.0)	1.2 (0.0)	2.0 (0.1)	1.2 (0.0)	1.2 (0.0)	0.9 (0.0)	1.4 (0.1)
∑REE + Y	284 (2)	282 (1)	262 (2)	255 (1)	290 (2)	271 (2)	267 (2)	202 (1)	180 (1)
$(La/Lu)_{CN}$	0.93 (0.23)	0.79 (0.20)	0.67 (0.19)	1.39 (0.32)	0.93 (0.19)	1.45 (0.35)	1.10 (0.27)	1.11 (0.27)	0.64 (0.15)
$(La/Sm)_{CN}$	0.44 (0.10)	0.38 (0.09)	0.50 (0.14)	0.90 (0.20)	1.31 (0.31)	1.21 (0.31)	0.83 (0.20)	0.74 (0.17)	1.12 (0.30)
$(La/Y)_{CN}$	0.69 (0.15)	0.60 (0.12)	0.61 (0.15)	1.44 (0.26)	1.13 (0.21)	1.31 (0.26)	0.96 (0.20)	0.91 (0.19)	0.74 (0.14)
$Eu_A = Eu/Eu^*$	0.83 (0.05)	0.78 (0.04)	0.90 (0.06)	0.88 (0.06)	0.97 (0.07)	0.88 (0.07)	0.84 (0.05)	0.82 (0.05)	1.03 (0.08)
$Ce_A = Ce/Ce^*$	1.06 (0.06)	1.03 (0.06)	1.00 (0.07)	1.06 (0.05)	1.08 (0.05)	1.13 (0.06)	1.10 (0.06)	1.02 (0.06)	1.09 (0.05)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_41	UK#3_42	UK#3_43	UK#3_44	UK#3_45	UK#3_46	UK#3_47	UK#3_48	UK#3_49
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	14.5 (0.4)	12.8 (0.5)	14.9 (0.6)	17.0 (0.6)	17.2 (0.9)	16.4 (0.6)	15.6 (0.5)	16.9 (1.5)	15.1 (0.7)
Fe	≤ LOD	≤ LOD	14 (28)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	18 (32)	17 (33)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	6 (11)	≤ LOD	2 (3)	2 (3)	2 (3)	8 (10)
Zn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	14 (13)	2 (2)	10 (9)	49 (46)
As	18 (1)	19 (1)	17 (1)	18 (1)	23 (2)	20 (3)	21 (2)	24 (5)	22 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	239.9 (4.0)	231.1 (3.0)	188.5 (3.0)	196.5 (4.4)	216.6 (4.6)	193.5 (3.5)	196.5 (3.2)	199.1 (3.7)	199.3 (2.9)
Y	75.2 (1.0)	76.4 (1.1)	106.5 (1.4)	107.7 (2.0)	112.1 (2.2)	98.1 (1.5)	100.9 (1.5)	90.9 (1.7)	93.6 (1.4)
Nb	77 (1)	80 (1)	145 (2)	137 (2)	141 (3)	136 (3)	133 (2)	113 (2)	120 (2)
Mo	2645 (44)	2809 (43)	2451 (41)	2389 (41)	2710 (52)	2559 (44)	2625 (45)	2669 (51)	2528 (44)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	753000 (14000)	775000 (12000)	760000 (14000)	740000 (15000)	775000 (17000)	764000 (14000)	754000 (15000)	750000 (15000)	761000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	7.1 (0.1)	6.5 (0.2)	5.3 (0.1)	5.3 (0.1)	8.4 (0.2)	5.9 (0.2)	8.1 (0.2)	6.0 (0.3)	7.4 (0.2)
Ce	22.6 (0.4)	21.6 (0.4)	25.9 (0.5)	24.2 (0.5)	34.8 (0.8)	25.0 (0.7)	31.1 (0.6)	23.6 (0.9)	29.4 (0.5)
Pr	3.4 (0.1)	3.5 (0.1)	5.4 (0.1)	5.0 (0.1)	6.4 (0.2)	4.8 (0.1)	5.7 (0.1)	4.2 (0.1)	5.5 (0.1)
Nd	17.9 (0.5)	19.7 (0.6)	35.9 (0.7)	33.4 (0.8)	37.7 (0.9)	29.4 (1.0)	32.9 (0.8)	26.1 (0.7)	32.3 (0.7)
Sm	5.5 (0.2)	6.5 (0.3)	12.5 (0.4)	12.3 (0.4)	12.1 (0.5)	10.5 (0.4)	11.6 (0.4)	9.1 (0.4)	10.6 (0.4)
Eu	1.96 (0.08)	2.21 (0.08)	3.96 (0.11)	3.90 (0.11)	3.97 (0.14)	3.51 (0.10)	3.83 (0.12)	2.99 (0.09)	3.25 (0.11)
Gd	7.2 (0.3)	8.5 (0.3)	17.5 (0.6)	17.3 (0.5)	16.9 (0.6)	14.4 (0.4)	14.9 (0.4)	12.0 (0.4)	14.7 (0.5)
Tb	1.2 (0.0)	1.4 (0.1)	2.8 (0.1)	2.9 (0.1)	2.6 (0.1)	2.4 (0.1)	2.4 (0.1)	2.0 (0.0)	2.3 (0.1)
Dy	9.8 (0.2)	10.4 (0.3)	19.7 (0.5)	20.3 (0.4)	19.0 (0.7)	16.9 (0.4)	17.3 (0.4)	15.0 (0.4)	16.2 (0.4)
Ho	2.3 (0.1)	2.6 (0.1)	4.5 (0.1)	4.5 (0.1)	4.6 (0.1)	3.9 (0.1)	4.0 (0.1)	3.4 (0.1)	3.7 (0.1)
Er	8.8 (0.3)	8.7 (0.3)	13.4 (0.3)	14.0 (0.4)	14.0 (0.4)	12.3 (0.3)	12.2 (0.3)	11.3 (0.3)	11.6 (0.3)
Tm	1.5 (0.1)	1.4 (0.0)	1.7 (0.1)	1.8 (0.0)	1.7 (0.1)	1.7 (0.1)	1.8 (0.1)	1.6 (0.1)	1.5 (0.1)
Yb	9.2 (0.3)	9.5 (0.3)	9.2 (0.3)	9.4 (0.3)	9.8 (0.3)	10.1 (0.3)	10.1 (0.4)	9.4 (0.3)	8.7 (0.2)
Lu	1.4 (0.1)	1.3 (0.0)	1.2 (0.0)	1.2 (0.1)	1.3 (0.1)	1.4 (0.0)	1.5 (0.0)	1.3 (0.1)	1.2 (0.0)
∑REE + Y	175 (1)	180 (1)	265 (1)	263 (1)	285 (2)	240 (1)	258 (1)	219 (1)	242 (1)
$(La/Lu)_{CN}$	0.53 (0.13)	0.51 (0.12)	0.44 (0.11)	0.46 (0.12)	0.65 (0.17)	0.44 (0.11)	0.58 (0.13)	0.47 (0.14)	0.62 (0.16)
$(La/Sm)_{CN}$	0.81 (0.20)	0.63 (0.17)	0.26 (0.06)	0.27 (0.07)	0.43 (0.11)	0.35 (0.09)	0.44 (0.10)	0.41 (0.13)	0.44 (0.11)
$(La/Y)_{CN}$	0.63 (0.11)	0.57 (0.11)	0.33 (0.06)	0.33 (0.07)	0.50 (0.10)	0.40 (0.09)	0.54 (0.10)	0.44 (0.11)	0.52 (0.11)
$Eu_A = Eu/Eu^*$	0.95 (0.07)	0.90 (0.07)	0.81 (0.05)	0.81 (0.05)	0.84 (0.06)	0.86 (0.05)	0.89 (0.05)	0.87 (0.06)	0.79 (0.05)
$Ce_A = Ce/Ce^*$	1.09 (0.05)	1.07 (0.06)	1.04 (0.06)	1.01 (0.06)	1.07 (0.07)	1.05 (0.07)	1.04 (0.06)	1.07 (0.08)	1.05 (0.05)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_50	UK#3_51	UK#3_52	UK#3_53	UK#3_54	UK#3_55	UK#3_56	UK#3_57	UK#3_58
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1)	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	14.8 (0.5)	16.4 (0.6)	14.6 (0.5)	17.2 (0.7)	15.5 (0.6)	14.6 (0.4)	17.0 (0.5)	15.7 (0.6)	16.7 (0.6)
Fe	47 (96)	≤ LOD	80 (83)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (3)	≤ LOD	2 (5)	3 (4)	≤ LOD
Zn	2 (2)	2 (2)	2 (3)	≤ LOD	12 (13)	17 (21)	7 (8)	2 (3)	7 (12)
As	32 (6)	31 (3)	19 (4)	22 (3)	24 (2)	24 (5)	21 (3)	14 (1)	26 (6)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	197.3 (3.3)	201.2 (4.0)	197.9 (3.2)	231.6 (3.9)	238.0 (4.6)	258.8 (4.6)	275.1 (4.9)	201.0 (4.1)	233.6 (5.1)
Y	87.8 (1.4)	106.5 (2.0)	101.9 (2.0)	102.0 (1.7)	101.0 (2.2)	90.7 (1.6)	70.1 (1.1)	98.4 (1.8)	81.0 (1.6)
Nb	100 (2)	137 (2)	166 (3)	140 (3)	114 (3)	114 (2)	128 (2)	165 (4)	83 (1)
Mo	2209 (43)	2107 (45)	2425 (32)	2395 (39)	2656 (58)	2689 (33)	2232 (32)	2365 (40)	2813 (47)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	758000 (15000)	743000 (19000)	751000 (16000)	763000 (16000)	756000 (16000)	756000 (11000)	756000 (16000)	769000 (18000)	748000 (15000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	9.4 (0.3)	11.6 (0.3)	7.9 (0.2)	9.2 (0.2)	9.8 (0.2)	12.3 (0.2)	17.6 (0.3)	7.9 (0.2)	9.1 (0.2)
Ce	33.7 (0.8)	40.9 (0.9)	33.2 (0.6)	37.0 (0.8)	36.7 (0.9)	37.3 (0.5)	54.5 (0.9)	31.8 (0.6)	28.3 (0.5)
Pr	5.4 (0.1)	6.9 (0.2)	6.7 (0.1)	6.7 (0.2)	6.2 (0.2)	5.4 (0.1)	8.3 (0.2)	6.2 (0.1)	4.3 (0.1)
Nd	31.1 (0.6)	39.8 (1.1)	44.1 (0.9)	41.1 (1.0)	35.2 (0.8)	26.9 (0.6)	41.1 (0.9)	37.9 (0.8)	22.2 (0.5)
Sm	9.0 (0.4)	12.6 (0.4)	16.3 (0.4)	13.4 (0.4)	11.1 (0.4)	7.5 (0.3)	10.4 (0.3)	13.4 (0.4)	6.7 (0.3)
Eu	3.11 (0.10)	4.08 (0.09)	4.67 (0.13)	4.10 (0.11)	3.52 (0.11)	2.56 (0.09)	3.27 (0.10)	4.19 (0.13)	2.29 (0.07)
Gd	12.4 (0.3)	17.8 (0.6)	21.4 (0.4)	17.3 (0.5)	14.9 (0.4)	9.4 (0.4)	11.4 (0.4)	17.7 (0.5)	8.7 (0.4)
Tb	2.0 (0.1)	2.7 (0.1)	3.2 (0.1)	2.7 (0.1)	2.3 (0.1)	1.6 (0.1)	1.8 (0.1)	2.9 (0.1)	1.4 (0.1)
Dy	13.9 (0.4)	18.7 (0.4)	21.6 (0.6)	18.3 (0.5)	16.7 (0.5)	12.0 (0.3)	12.3 (0.3)	20.0 (0.6)	11.0 (0.3)
Ho	3.3 (0.1)	4.4 (0.1)	4.5 (0.1)	4.2 (0.1)	3.8 (0.1)	3.0 (0.1)	2.7 (0.1)	4.3 (0.1)	2.7 (0.1)
Er	10.6 (0.3)	13.5 (0.3)	12.9 (0.3)	12.3 (0.3)	12.2 (0.3)	10.7 (0.3)	8.6 (0.3)	12.0 (0.4)	9.2 (0.2)
Tm	1.4 (0.0)	1.8 (0.1)	1.7 (0.1)	1.6 (0.1)	1.7 (0.0)	1.7 (0.1)	1.2 (0.0)	1.6 (0.1)	1.4 (0.0)
Yb	8.4 (0.3)	9.8 (0.3)	9.3 (0.3)	9.2 (0.3)	10.0 (0.3)	10.7 (0.3)	7.5 (0.2)	9.0 (0.3)	9.4 (0.2)
Lu	1.2 (0.1)	1.4 (0.0)	1.3 (0.1)	1.2 (0.1)	1.4 (0.1)	1.4 (0.1)	1.1 (0.0)	1.3 (0.0)	1.4 (0.0)
∑REE + Y	233 (1)	292 (2)	291 (1)	280 (2)	266 (1)	233 (1)	252 (1)	269 (1)	199 (1)
$(La/Lu)_{CN}$	0.82 (0.23)	0.88 (0.21)	0.65 (0.16)	0.77 (0.20)	0.74 (0.18)	0.90 (0.23)	1.70 (0.38)	0.64 (0.15)	0.68 (0.15)
$(La/Sm)_{CN}$	0.66 (0.18)	0.58 (0.13)	0.30 (0.06)	0.43 (0.10)	0.55 (0.13)	1.02 (0.23)	1.06 (0.23)	0.37 (0.08)	0.85 (0.22)
$(La/Y)_{CN}$	0.71 (0.16)	0.72 (0.15)	0.51 (0.10)	0.60 (0.11)	0.64 (0.14)	0.90 (0.17)	1.67 (0.30)	0.53 (0.10)	0.75 (0.15)
$Eu_A = Eu/Eu^*$	0.90 (0.06)	0.83 (0.04)	0.76 (0.04)	0.82 (0.05)	0.83 (0.05)	0.92 (0.06)	0.91 (0.05)	0.82 (0.05)	0.91 (0.07)
$Ce_A = Ce/Ce^*$	1.10 (0.07)	1.07 (0.06)	1.01 (0.05)	1.07 (0.06)	1.10 (0.06)	1.09 (0.05)	1.08 (0.05)	1.02 (0.06)	1.08 (0.06)

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TABLE E3. *(continued)*

Sample (ppm)	UK#3_59	UK#3_60
Li	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD
Mn	15.0 (0.6)	16.9 (0.7)
Fe	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD
Zn	2 (2)	5 (6)
As	25 (6)	25 (3)
Rb	≤ LOD	≤ LOD
Sr	217.2 (5.1)	246.6 (5.2)
Y	86.4 (2.0)	78.4 (1.5)
Nb	97 (3)	77 (1)
Mo	2838 (49)	2891 (58)
Ag	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD
W	763000 (16000)	755000 (19000)
Th	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD
La	7.4 (0.1)	10.5 (0.3)
Ce	26.8 (0.6)	30.2 (0.6)
Pr	4.5 (0.1)	4.2 (0.1)
Nd	24.8 (0.7)	20.8 (0.6)
Sm	8.0 (0.3)	5.8 (0.3)
Eu	2.53 (0.10)	2.04 (0.08)
Gd	10.1 (0.4)	7.9 (0.3)
Tb	1.8 (0.1)	1.3 (0.0)
Dy	12.7 (0.4)	10.0 (0.3)
Ho	3.1 (0.1)	2.5 (0.1)
Er	10.5 (0.4)	9.1 (0.2)
Tm	1.7 (0.1)	1.4 (0.0)
Yb	10.3 (0.4)	9.7 (0.3)
Lu	1.5 (0.1)	1.4 (0.1)
∑REE + Y	212 (1)	195 (1)
$(La/Lu)_{CN}$	0.51 (0.12)	0.75 (0.19)
$(La/Sm)_{CN}$	0.58 (0.14)	1.15 (0.31)
$(La/Y)_{CN}$	0.57 (0.12)	0.89 (0.19)
$Eu_A = Eu/Eu^*$	0.86 (0.06)	0.92 (0.07)
$Ce_A = Ce/Ce^*$	1.09 (0.06)	1.09 (0.06)

TABLE E4. Major and trace element compositions of scheelite from UK #4 (MPB-13-006).

Sample (ppm)	UK#4_1	UK#4_2	UK#4_3	UK#4_4	UK#4_5
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	20.1 (0.6)	17.5 (0.7)	18.8 (1.2)	27.1 (3.8)	18.7 (0.8)
Fe	≤ LOD	≤ LOD	≤ LOD	42 (22)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	5 (7)	≤ LOD	3 (2)	110 (200)	≤ LOD
Zn	3 (4)	5 (6)	5 (5)	3 (1)	≤ LOD
As	56 (3)	106 (5)	110 (4)	44 (5)	35 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	63.7 (1.4)	65.0 (1.3)	64.8 (1.6)	79.8 (1.1)	67.7 (1.5)
Y	195.2 (3.7)	299.1 (5.9)	313.7 (6.9)	155.5 (2.4)	154.2 (3.3)
Nb	81 (2)	130 (2)	125 (3)	42 (1)	35 (1)
Mo	577 (14)	652 (13)	629 (12)	474 (9)	524 (7)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	729000 (21000)	724000 (17000)	711000 (15000)	725000 (15000)	724000 (16000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	9.9 (0.2)	13.9 (0.3)	16.9 (0.5)	2.5 (0.1)	6.2 (0.1)
Ce	41.6 (1.0)	65.0 (1.1)	74.9 (1.4)	16.7 (0.4)	32.7 (0.7)
Pr	8.3 (0.3)	13.5 (0.3)	15.0 (0.3)	4.6 (0.1)	7.1 (0.2)
Nd	54.9 (1.6)	93.4 (2.2)	100.2 (1.9)	39.0 (0.9)	48.3 (1.3)
Sm	25.9 (0.8)	42.7 (1.2)	46.9 (1.0)	18.4 (0.6)	21.1 (0.7)
Eu	2.97 (0.11)	5.09 (0.12)	5.50 (0.14)	2.26 (0.08)	2.15 (0.08)
Gd	47.0 (1.0)	75.5 (1.9)	81.6 (2.0)	35.6 (0.8)	36.5 (0.8)
Tb	7.9 (0.2)	12.0 (0.3)	12.8 (0.3)	6.0 (0.1)	5.8 (0.1)
Dy	48.9 (1.1)	74.0 (1.8)	77.9 (1.8)	39.9 (0.7)	37.5 (0.9)
Ho	9.6 (0.3)	14.1 (0.3)	15.0 (0.3)	8.3 (0.2)	7.4 (0.2)
Er	21.8 (0.5)	31.7 (0.7)	32.8 (0.8)	18.8 (0.4)	16.5 (0.5)
Tm	2.1 (0.1)	3.1 (0.1)	3.3 (0.1)	1.8 (0.1)	1.6 (0.1)
Yb	8.7 (0.3)	14.2 (0.4)	14.4 (0.3)	7.7 (0.2)	7.4 (0.3)
Lu	1.0 (0.1)	1.6 (0.0)	1.7 (0.1)	1.0 (0.0)	0.9 (0.0)
∑REE + Y	486 (3)	759 (4)	813 (4)	358 (2)	385 (2)
$(La/Lu)_{CN}$	0.99 (0.27)	0.88 (0.20)	1.00 (0.25)	0.25 (0.06)	0.70 (0.18)
$(La/Sm)_{CN}$	0.24 (0.05)	0.20 (0.04)	0.23 (0.05)	0.08 (0.02)	0.18 (0.04)
$(La/Y)_{CN}$	0.34 (0.07)	0.31 (0.06)	0.36 (0.08)	0.11 (0.02)	0.27 (0.06)
$Eu_A = Eu/Eu^*$	0.26 (0.01)	0.27 (0.01)	0.27 (0.01)	0.26 (0.02)	0.23 (0.01)
$Ce_A = Ce/Ce^*$	1.02 (0.07)	1.03 (0.05)	1.03 (0.06)	0.89 (0.05)	1.02 (0.06)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_6	UK#4_7	UK#4_8	UK#4_9	UK#4_10	UK#4_11	UK#4_12	UK#4_13	UK#4_14
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	17.7 (0.5)	10.8 (0.3)	10.0 (0.5)	8.4 (0.3)	22.2 (0.7)	17.4 (1.7)	20.2 (1.4)	18.3 (0.6)	13.5 (0.5)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2)	≤ LOD
Zn	≤ LOD	2 (2)	6 (9)	≤ LOD	3 (3)	≤ LOD	≤ LOD	5 (3)	≤ LOD
As	36 (2)	32 (3)	110 (4)	101 (3)	33 (3)	30 (4)	23 (2)	66 (10)	97 (10)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	78.2 (1.4)	59.3 (1.4)	70.4 (1.8)	59.6 (1.2)	66.4 (1.3)	65.6 (1.6)	58.2 (1.5)	87.4 (1.6)	82.5 (1.6)
Y	150.5 (2.7)	66.2 (1.3)	238.7 (4.7)	219.9 (3.9)	82.5 (1.7)	128.3 (4.2)	57.8 (1.3)	233.5 (4.2)	274.9 (4.8)
Nb	37 (1)	48 (1)	169 (3)	161 (3)	38 (1)	43 (1)	30 (1)	64 (1)	130 (3)
Mo	508 (10)	514 (10)	557 (10)	546 (13)	634 (12)	633 (13)	636 (19)	555 (12)	606 (14)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	715000 (16000)	716000 (15000)	720000 (15000)	714000 (16000)	733000 (17000)	720000 (16000)	731000 (20000)	729000 (15000)	731000 (20000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	2.7 (0.1)	4.7 (0.1)	20.6 (0.3)	17.5 (0.3)	3.0 (0.1)	5.6 (0.3)	5.0 (0.2)	6.5 (0.3)	5.6 (0.2)
Ce	17.3 (0.3)	17.9 (0.4)	72.0 (1.4)	62.7 (1.2)	19.7 (0.4)	36.8 (2.0)	25.0 (0.7)	39.9 (1.5)	36.3 (0.8)
Pr	4.8 (0.1)	3.4 (0.1)	12.7 (0.3)	11.5 (0.3)	5.2 (0.1)	8.9 (0.4)	5.0 (0.2)	9.7 (0.4)	9.7 (0.3)
Nd	41.2 (0.9)	23.3 (0.5)	80.1 (1.9)	72.9 (1.6)	39.7 (1.0)	63.6 (2.1)	31.1 (1.0)	70.7 (2.3)	79.1 (1.9)
Sm	21.1 (0.5)	10.9 (0.4)	34.5 (0.9)	33.2 (0.8)	14.1 (0.4)	21.4 (0.5)	10.1 (0.4)	34.9 (1.1)	41.0 (0.9)
Eu	2.75 (0.10)	1.28 (0.05)	4.14 (0.14)	3.53 (0.09)	2.06 (0.08)	2.57 (0.08)	1.29 (0.05)	3.96 (0.11)	4.55 (0.18)
Gd	39.6 (0.7)	19.0 (0.5)	58.9 (1.5)	56.1 (1.4)	22.1 (0.6)	31.6 (0.8)	14.5 (0.5)	63.3 (1.6)	76.7 (1.8)
Tb	6.3 (0.2)	3.0 (0.1)	9.3 (0.2)	8.9 (0.2)	3.3 (0.1)	4.7 (0.1)	2.2 (0.1)	9.8 (0.2)	12.1 (0.3)
Dy	39.9 (0.8)	17.6 (0.5)	59.0 (1.5)	55.9 (1.3)	21.2 (0.6)	31.0 (1.0)	14.0 (0.4)	61.6 (1.1)	75.0 (1.5)
Ho	7.7 (0.2)	3.2 (0.1)	11.2 (0.2)	10.4 (0.2)	4.3 (0.1)	6.3 (0.2)	2.7 (0.1)	11.8 (0.2)	13.7 (0.3)
Er	17.4 (0.4)	6.9 (0.2)	25.9 (0.6)	24.0 (0.5)	10.5 (0.3)	14.7 (0.5)	6.7 (0.2)	25.7 (0.6)	30.6 (0.6)
Tm	1.7 (0.0)	0.7 (0.0)	2.8 (0.1)	2.5 (0.1)	1.1 (0.0)	1.5 (0.1)	0.7 (0.0)	2.4 (0.1)	2.9 (0.1)
Yb	7.5 (0.3)	3.2 (0.1)	12.5 (0.4)	11.2 (0.3)	5.0 (0.3)	6.8 (0.2)	3.0 (0.2)	10.2 (0.3)	12.2 (0.3)
Lu	0.9 (0.0)	≤ LOD	1.5 (0.1)	1.3 (0.0)	0.6 (0.0)	0.8 (0.0)	≤ LOD	1.1 (0.0)	1.4 (0.0)
∑REE + Y	361 (2)	181 (1)	644 (3)	591 (3)	234 (2)	365 (3)	179 (1)	585 (4)	676 (3)
$(La/Lu)_{CN}$	0.32 (0.09)	1.31 (0.39)	1.42 (0.31)	1.36 (0.30)	0.48 (0.14)	0.73 (0.23)	1.42 (0.47)	0.60 (0.17)	0.40 (0.10)
$(La/Sm)_{CN}$	0.08 (0.02)	0.27 (0.07)	0.37 (0.08)	0.33 (0.07)	0.13 (0.03)	0.16 (0.05)	0.31 (0.08)	0.12 (0.03)	0.08 (0.02)
$(La/Y)_{CN}$	0.12 (0.03)	0.47 (0.10)	0.57 (0.11)	0.53 (0.10)	0.24 (0.05)	0.29 (0.09)	0.57 (0.14)	0.19 (0.05)	0.13 (0.03)
$Eu_A = Eu/Eu^*$	0.29 (0.02)	0.27 (0.02)	0.28 (0.02)	0.25 (0.01)	0.35 (0.02)	0.30 (0.02)	0.32 (0.02)	0.25 (0.01)	0.24 (0.01)
$Ce_A = Ce/Ce^*$	0.88 (0.05)	1.02 (0.06)	1.03 (0.05)	1.02 (0.05)	0.93 (0.06)	0.98 (0.10)	1.06 (0.07)	0.97 (0.09)	0.91 (0.06)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_15	UK#4_16	UK#4_17	UK#4_18	UK#4_19	UK#4_20	UK#4_21	UK#4_22	UK#4_23
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	3 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	14.4 (0.6)	19.1 (0.9)	18.6 (0.7)	34.8 (6.2)	18.3 (0.7)	18.5 (0.8)	16.2 (0.9)	16.2 (0.5)	24.7 (8.5)
Fe	≤ LOD	6 (24)	≤ LOD	67 (25)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	90 (77)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	4 (6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	30 (34)	≤ LOD	16 (6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2)
As	57 (6)	46 (3)	35 (1)	50 (3)	102 (4)	115 (5)	90 (3)	28 (1)	36 (6)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	89.8 (2.0)	81.1 (2.2)	71.7 (1.6)	90.2 (2.0)	89.9 (2.9)	81.2 (1.7)	77.1 (1.9)	58.8 (1.2)	60.5 (1.4)
Y	202.8 (3.8)	217.3 (5.5)	162.1 (3.2)	249.4 (5.3)	293.3 (6.7)	316.2 (5.9)	307.0 (5.9)	141.4 (2.9)	212.9 (4.4)
Nb	62 (3)	54 (1)	43 (1)	60 (2)	147 (3)	157 (3)	151 (3)	53 (1)	43 (1)
Mo	538 (10)	566 (14)	568 (14)	626 (15)	688 (12)	727 (17)	662 (14)	421 (9)	560 (9)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	723000 (14000)	726000 (22000)	739000 (18000)	716000 (21000)	723000 (18000)	727000 (15000)	723000 (16000)	714000 (16000)	725000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	6.7 (0.2)	6.6 (0.1)	4.9 (0.1)	6.1 (0.2)	11.5 (0.3)	13.6 (0.3)	5.7 (0.2)	12.8 (0.3)	10.0 (0.3)
Ce	34.7 (1.0)	37.9 (1.0)	29.6 (0.7)	35.8 (0.7)	53.5 (1.3)	61.0 (1.1)	35.6 (1.0)	46.5 (1.1)	49.1 (1.1)
Pr	8.0 (0.2)	8.7 (0.3)	7.5 (0.2)	9.1 (0.2)	11.9 (0.3)	13.2 (0.3)	9.5 (0.3)	7.9 (0.2)	10.6 (0.3)
Nd	62.1 (1.6)	65.4 (1.8)	60.0 (1.6)	72.5 (1.6)	88.3 (1.9)	93.1 (1.7)	80.7 (2.2)	45.3 (1.1)	72.5 (1.5)
Sm	30.7 (0.8)	32.6 (1.0)	29.6 (0.9)	38.8 (0.9)	42.3 (1.1)	45.7 (1.0)	42.7 (1.3)	19.0 (0.6)	33.0 (0.8)
Eu	3.53 (0.12)	3.97 (0.13)	3.95 (0.11)	3.78 (0.13)	4.39 (0.11)	4.52 (0.13)	3.61 (0.12)	2.61 (0.10)	3.46 (0.10)
Gd	56.1 (1.4)	57.1 (1.7)	52.8 (1.3)	74.4 (1.9)	76.6 (1.6)	83.0 (2.1)	84.9 (2.2)	32.3 (1.0)	57.3 (1.2)
Tb	8.7 (0.2)	9.4 (0.3)	7.8 (0.2)	11.6 (0.3)	12.0 (0.2)	12.6 (0.2)	13.2 (0.3)	5.2 (0.1)	8.6 (0.2)
Dy	55.3 (1.4)	58.7 (1.7)	46.7 (1.1)	70.8 (1.3)	74.6 (1.6)	80.1 (1.3)	82.5 (1.9)	32.6 (0.9)	54.5 (1.1)
Ho	10.5 (0.2)	11.2 (0.4)	8.8 (0.2)	12.9 (0.3)	14.1 (0.3)	15.2 (0.3)	15.5 (0.4)	6.1 (0.2)	10.3 (0.3)
Er	22.5 (0.6)	24.5 (0.7)	18.1 (0.4)	27.9 (0.7)	31.9 (0.7)	34.5 (0.7)	34.9 (0.7)	14.4 (0.4)	22.4 (0.5)
Tm	2.1 (0.1)	2.4 (0.1)	1.6 (0.1)	2.5 (0.1)	3.3 (0.1)	3.5 (0.1)	3.3 (0.1)	1.5 (0.1)	2.2 (0.1)
Yb	9.1 (0.3)	10.1 (0.4)	6.7 (0.2)	9.5 (0.3)	14.6 (0.4)	15.3 (0.3)	13.5 (0.4)	6.7 (0.2)	9.2 (0.3)
Lu	1.1 (0.0)	1.1 (0.0)	0.8 (0.0)	1.1 (0.1)	1.8 (0.1)	1.8 (0.1)	1.7 (0.1)	0.8 (0.0)	1.1 (0.1)
∑REE + Y	514 (3)	547 (3)	441 (3)	626 (3)	734 (4)	793 (3)	734 (4)	375 (2)	557 (3)
$(La/Lu)_{CN}$	0.64 (0.17)	0.60 (0.14)	0.65 (0.16)	0.58 (0.16)	0.66 (0.16)	0.77 (0.18)	0.35 (0.09)	1.76 (0.43)	0.95 (0.26)
$(La/Sm)_{CN}$	0.14 (0.03)	0.13 (0.03)	0.10 (0.02)	0.10 (0.02)	0.17 (0.04)	0.19 (0.04)	0.08 (0.02)	0.42 (0.10)	0.19 (0.04)
$(La/Y)_{CN}$	0.22 (0.05)	0.20 (0.04)	0.20 (0.04)	0.16 (0.04)	0.26 (0.06)	0.29 (0.06)	0.12 (0.03)	0.60 (0.12)	0.31 (0.07)
$Eu_A = Eu/Eu^*$	0.26 (0.01)	0.28 (0.02)	0.30 (0.02)	0.21 (0.01)	0.23 (0.01)	0.22 (0.01)	0.18 (0.01)	0.32 (0.02)	0.24 (0.01)
$Ce_A = Ce/Ce^*$	0.98 (0.07)	1.00 (0.07)	0.94 (0.06)	0.93 (0.06)	0.97 (0.06)	0.98 (0.05)	0.90 (0.07)	1.08 (0.06)	1.00 (0.06)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_24	UK#4_25	UK#4_26	UK#4_27	UK#4_28	UK#4_29	UK#4_30	UK#4_31	UK#4_32
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	16.0 (0.5)	17.9 (0.5)	19.0 (0.5)	17.9 (0.6)	17.1 (0.6)	20.1 (0.7)	22.0 (0.7)	18.3 (0.6)	15.4 (0.4)
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	3 (6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (5)	≤ LOD
Zn	≤ LOD	≤ LOD	9 (14)	4 (4)	4 (8)	≤ LOD	5 (7)	≤ LOD	≤ LOD
As	27 (1)	37 (2)	49 (2)	67 (3)	32 (3)	41 (2)	44 (1)	290 (520)	80 (7)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	59.3 (1.3)	65.5 (1.0)	71.0 (1.2)	70.3 (1.4)	60.7 (1.1)	64.4 (1.4)	66.4 (1.1)	61.6 (1.3)	56.8 (1.1)
Y	149.5 (2.4)	202.4 (3.6)	203.4 (5.1)	228.7 (4.7)	139.0 (2.3)	198.3 (3.4)	145.6 (2.8)	135.0 (3.0)	244.7 (9.1)
Nb	38 (1)	44 (1)	59 (1)	76 (2)	30 (1)	52 (1)	40 (2)	45 (1)	141 (2)
Mo	551 (9)	527 (9)	617 (12)	697 (12)	551 (11)	603 (12)	549 (9)	606 (11)	402 (16)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	719000 (13000)	717000 (17000)	731000 (13000)	706000 (15000)	731000 (15000)	716000 (13000)	703000 (13000)	718000 (17000)	711000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	6.8 (0.2)	4.5 (0.1)	3.3 (0.1)	3.8 (0.1)	6.9 (0.2)	7.5 (0.2)	5.3 (0.2)	3.2 (0.1)	11.2 (0.3)
Ce	30.9 (0.7)	26.3 (0.5)	20.2 (0.6)	22.7 (0.8)	30.8 (0.6)	39.4 (0.7)	26.7 (0.8)	14.6 (0.4)	41.3 (1.5)
Pr	6.8 (0.2)	7.0 (0.2)	5.8 (0.2)	6.5 (0.2)	6.8 (0.2)	9.1 (0.2)	6.2 (0.2)	3.7 (0.1)	7.8 (0.3)
Nd	51.8 (1.3)	58.3 (1.3)	54.5 (1.4)	60.6 (1.6)	48.9 (1.0)	67.5 (1.3)	47.5 (1.1)	32.8 (0.8)	50.9 (2.6)
Sm	25.0 (0.5)	30.3 (0.8)	30.2 (0.7)	35.0 (0.7)	22.0 (0.7)	31.5 (0.8)	23.1 (0.7)	18.8 (0.5)	25.5 (1.6)
Eu	3.32 (0.10)	3.13 (0.10)	3.09 (0.09)	3.50 (0.10)	2.26 (0.10)	3.13 (0.09)	2.61 (0.09)	2.01 (0.08)	3.74 (0.11)
Gd	47.8 (1.0)	59.6 (1.0)	59.5 (1.1)	67.1 (1.4)	39.4 (0.9)	55.9 (1.2)	41.1 (0.8)	38.2 (1.0)	49.2 (2.8)
Tb	6.9 (0.2)	8.9 (0.2)	9.0 (0.2)	10.4 (0.2)	5.8 (0.1)	8.5 (0.2)	6.3 (0.1)	5.9 (0.2)	8.5 (0.4)
Dy	42.5 (1.1)	55.1 (1.0)	54.6 (1.2)	62.5 (1.5)	36.4 (0.7)	52.1 (1.1)	38.5 (0.7)	35.8 (1.0)	57.2 (2.3)
Ho	7.9 (0.2)	10.2 (0.2)	10.6 (0.3)	11.8 (0.3)	6.6 (0.2)	9.9 (0.2)	7.3 (0.1)	6.7 (0.2)	11.6 (0.4)
Er	16.7 (0.3)	22.2 (0.4)	22.7 (0.5)	25.6 (0.5)	14.3 (0.3)	21.2 (0.4)	16.1 (0.4)	14.3 (0.4)	26.4 (0.8)
Tm	1.5 (0.0)	2.1 (0.1)	2.1 (0.1)	2.4 (0.1)	1.4 (0.0)	2.0 (0.1)	1.6 (0.0)	1.3 (0.1)	2.7 (0.1)
Yb	6.0 (0.2)	8.5 (0.2)	8.9 (0.3)	10.1 (0.3)	5.9 (0.2)	8.9 (0.3)	7.1 (0.2)	5.5 (0.2)	11.7 (0.5)
Lu	0.7 (0.0)	1.0 (0.0)	1.1 (0.0)	1.2 (0.1)	0.7 (0.0)	1.1 (0.0)	0.9 (0.0)	0.6 (0.0)	1.3 (0.1)
∑REE + Y	404 (2)	500 (2)	489 (2)	552 (3)	367 (2)	516 (2)	376 (2)	318 (2)	554 (5)
$(La/Lu)_{CN}$	0.97 (0.27)	0.45 (0.11)	0.31 (0.08)	0.32 (0.09)	0.98 (0.26)	0.74 (0.18)	0.61 (0.18)	0.52 (0.15)	0.87 (0.21)
$(La/Sm)_{CN}$	0.17 (0.04)	0.09 (0.02)	0.07 (0.02)	0.07 (0.02)	0.20 (0.05)	0.15 (0.03)	0.14 (0.04)	0.11 (0.02)	0.28 (0.08)
$(La/Y)_{CN}$	0.30 (0.06)	0.15 (0.03)	0.11 (0.03)	0.11 (0.03)	0.33 (0.07)	0.25 (0.05)	0.24 (0.06)	0.16 (0.03)	0.30 (0.07)
$Eu_A = Eu/Eu^*$	0.29 (0.01)	0.22 (0.01)	0.22 (0.01)	0.22 (0.01)	0.23 (0.01)	0.22 (0.01)	0.25 (0.01)	0.22 (0.01)	0.32 (0.03)
$Ce_A = Ce/Ce^*$	0.97 (0.06)	0.89 (0.06)	0.84 (0.06)	0.85 (0.07)	0.97 (0.06)	0.97 (0.05)	0.96 (0.07)	0.88 (0.06)	1.01 (0.08)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_33	UK#4_34	UK#4_35	UK#4_36	UK#4_37	UK#4_38	UK#4_39	UK#4_40	UK#4_41
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	15.0 (0.6)	19.0 (0.8)	16.9 (0.5)	17.5 (0.6)	14.9 (1.3)	12.1 (0.5)	12.7 (0.9)	11.8 (0.9)	13.0 (0.6)
Fe	≤ LOD	29 (62)	150 (170)	≤ LOD	440 (400)	5 (21)	≤ LOD	99 (96)	17 (30)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (2)	≤ LOD	≤ LOD	2 (3)	≤ LOD
Cu	≤ LOD	2 (2)	≤ LOD	≤ LOD	27 (16)	≤ LOD	2 (2)	15 (14)	5 (6)
Zn	≤ LOD	170 (270)	2 (3)	≤ LOD	250 (320)	4 (5)	4 (8)	15 (14)	42 (42)
As	162 (5)	58 (5)	54 (11)	50 (3)	163 (38)	145 (28)	110 (3)	320 (240)	111 (10)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	71.6 (1.3)	70.2 (1.2)	63.8 (0.9)	66.6 (1.3)	63.9 (1.3)	67.7 (1.2)	62.1 (1.3)	62.6 (1.3)	78.5 (1.7)
Y	297.0 (4.1)	169.8 (2.6)	204.3 (3.4)	236.8 (4.2)	269.0 (4.4)	275.8 (4.3)	268.5 (4.9)	188.8 (3.5)	220.2 (8.7)
Nb	148 (3)	65 (1)	43 (1)	60 (1)	221 (4)	211 (4)	209 (4)	144 (3)	156 (6)
Mo	710 (12)	657 (13)	585 (11)	630 (13)	597 (13)	605 (11)	600 (12)	565 (10)	557 (11)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	0.9 (0.8)	≤ LOD	≤ LOD	0.5 (0.5)	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	703000 (12000)	709000 (14000)	727000 (16000)	703000 (14000)	719000 (14000)	711000 (13000)	708000 (16000)	717700 (9800)	716000 (16000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	26.4 (0.6)	5.7 (0.1)	9.4 (0.2)	7.7 (0.3)	21.5 (0.5)	21.8 (0.3)	21.5 (0.4)	15.3 (0.2)	21.9 (1.0)
Ce	91.9 (2.1)	26.9 (0.5)	45.8 (1.0)	36.7 (1.5)	77.5 (1.6)	78.1 (1.3)	76.5 (1.4)	52.6 (0.9)	72.2 (3.3)
Pr	16.4 (0.4)	6.4 (0.2)	10.2 (0.2)	8.7 (0.3)	14.2 (0.3)	14.5 (0.3)	13.8 (0.3)	9.8 (0.2)	12.6 (0.5)
Nd	105.6 (2.4)	54.4 (1.3)	70.7 (1.7)	69.2 (1.7)	90.3 (2.2)	91.3 (1.8)	88.4 (2.1)	63.4 (1.1)	77.0 (3.1)
Sm	48.9 (1.3)	29.4 (0.9)	32.9 (0.8)	35.3 (1.0)	39.6 (1.0)	41.9 (1.0)	38.3 (1.0)	30.0 (0.7)	33.7 (1.4)
Eu	4.39 (0.13)	3.75 (0.10)	3.46 (0.10)	3.68 (0.12)	3.60 (0.15)	3.97 (0.13)	3.67 (0.10)	2.70 (0.07)	3.65 (0.19)
Gd	84.3 (1.5)	57.5 (1.4)	56.8 (1.4)	63.6 (1.5)	68.7 (1.8)	70.5 (1.6)	66.9 (1.9)	51.7 (1.0)	58.4 (2.2)
Tb	12.7 (0.3)	8.3 (0.1)	8.5 (0.2)	10.1 (0.2)	10.7 (0.3)	10.8 (0.2)	10.5 (0.2)	7.9 (0.2)	9.0 (0.4)
Dy	75.8 (1.5)	49.3 (0.9)	52.8 (1.0)	61.5 (1.3)	66.3 (1.7)	67.3 (1.3)	65.5 (1.6)	48.6 (1.2)	56.2 (2.4)
Ho	13.3 (0.3)	9.1 (0.2)	9.7 (0.2)	11.8 (0.2)	12.4 (0.3)	12.7 (0.2)	12.2 (0.3)	9.0 (0.2)	10.4 (0.4)
Er	29.1 (0.6)	19.4 (0.4)	21.3 (0.4)	25.8 (0.5)	27.4 (0.6)	29.0 (0.5)	27.7 (0.7)	19.7 (0.5)	23.1 (0.8)
Tm	3.0 (0.1)	1.8 (0.1)	2.0 (0.1)	2.5 (0.1)	2.9 (0.1)	3.0 (0.1)	2.8 (0.1)	2.0 (0.1)	2.5 (0.1)
Yb	13.4 (0.4)	6.9 (0.2)	8.4 (0.3)	10.6 (0.3)	13.3 (0.4)	14.2 (0.4)	13.2 (0.4)	8.6 (0.3)	11.0 (0.6)
Lu	1.7 (0.1)	0.8 (0.0)	1.0 (0.1)	1.2 (0.0)	1.7 (0.1)	1.7 (0.1)	1.6 (0.1)	1.0 (0.0)	1.3 (0.1)
∑REE + Y	824 (4)	449 (2)	537 (3)	585 (3)	719 (4)	737 (3)	711 (4)	511 (2)	613 (6)
$(La/Lu)_{CN}$	1.61 (0.37)	0.71 (0.17)	0.94 (0.25)	0.65 (0.17)	1.32 (0.32)	1.35 (0.29)	1.43 (0.33)	1.51 (0.36)	1.69 (0.54)
$(La/Sm)_{CN}$	0.34 (0.07)	0.12 (0.03)	0.18 (0.04)	0.14 (0.04)	0.34 (0.07)	0.33 (0.06)	0.35 (0.07)	0.32 (0.06)	0.41 (0.12)
$(La/Y)_{CN}$	0.59 (0.11)	0.22 (0.04)	0.30 (0.06)	0.22 (0.05)	0.53 (0.10)	0.53 (0.09)	0.53 (0.10)	0.54 (0.10)	0.66 (0.19)
$Eu_A = Eu/Eu^*$	0.21 (0.01)	0.27 (0.01)	0.24 (0.01)	0.23 (0.01)	0.21 (0.01)	0.22 (0.01)	0.22 (0.01)	0.21 (0.01)	0.25 (0.02)
$Ce_A = Ce/Ce^*$	1.03 (0.06)	0.93 (0.06)	0.98 (0.06)	0.93 (0.07)	1.02 (0.05)	1.01 (0.05)	1.03 (0.05)	0.99 (0.05)	1.02 (0.09)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_42	UK#4_43	UK#4_44	UK#4_45	UK#4_46	UK#4_47	UK#4_48	UK#4_49	UK#4_50
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	1600 (860)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	13.5 (0.7)	17.7 (0.7)	22.5 (1.0)	20.8 (0.9)	19.6 (0.5)	19.3 (0.6)	24.7 (2.2)	11.5 (0.5)	10.0 (0.7)
Fe	67 (76)	730 (430)	360 (230)	740 (540)	≤ LOD	≤ LOD	16 (7)	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	3 (2)	2 (3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	30 (41)	35 (19)	18 (18)	27 (16)	≤ LOD	≤ LOD	≤ LOD	2 (4)	≤ LOD
Zn	17 (10)	32 (21)	125 (71)	117 (61)	2 (2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD
As	93 (16)	430 (390)	950 (700)	330 (190)	27 (1)	35 (1)	42 (2)	97 (3)	108 (5)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	62.2 (1.2)	69.2 (1.7)	88.9 (2.2)	65.8 (1.5)	57.4 (1.1)	60.4 (1.0)	65.2 (1.5)	70.6 (1.8)	74.5 (1.5)
Y	149.6 (4.0)	133.9 (2.7)	147.0 (4.4)	225.4 (4.7)	126.5 (2.6)	175.6 (2.5)	168.7 (3.5)	174.9 (3.8)	178.7 (3.0)
Nb	113 (3)	32 (1)	36 (1)	124 (3)	32 (1)	37 (1)	51 (1)	103 (2)	99 (2)
Mo	561 (11)	527 (13)	559 (14)	664 (30)	540 (10)	552 (9)	578 (10)	571 (11)	572 (9)
Ag	≤ LOD	1.0 (1.0)	0.8 (0.5)	0.8 (0.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	719000 (14000)	704000 (18000)	698000 (19000)	716000 (19000)	700000 (12000)	715000 (14000)	708000 (14000)	713000 (18000)	715000 (12000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	14.6 (0.7)	2.6 (0.1)	2.7 (0.1)	9.6 (0.3)	5.1 (0.1)	2.7 (0.1)	2.9 (0.1)	14.9 (0.3)	15.7 (0.2)
Ce	49.2 (2.2)	16.8 (0.5)	16.6 (0.6)	50.0 (1.3)	25.2 (0.6)	16.8 (0.4)	17.2 (0.4)	50.7 (1.2)	53.4 (0.9)
Pr	8.4 (0.3)	4.7 (0.2)	4.6 (0.2)	11.2 (0.3)	5.6 (0.1)	4.9 (0.1)	4.7 (0.1)	9.3 (0.2)	9.6 (0.2)
Nd	53.5 (2.0)	39.4 (1.1)	39.4 (1.1)	78.9 (1.8)	41.6 (0.9)	42.6 (0.9)	40.6 (0.9)	59.8 (1.3)	61.3 (1.3)
Sm	24.4 (1.0)	19.5 (0.7)	20.0 (0.6)	36.2 (1.1)	19.7 (0.5)	23.5 (0.6)	24.0 (0.7)	27.3 (0.7)	28.4 (0.8)
Eu	2.41 (0.12)	2.13 (0.08)	2.23 (0.09)	3.95 (0.12)	2.06 (0.08)	2.32 (0.09)	2.26 (0.08)	2.88 (0.10)	3.00 (0.11)
Gd	41.2 (1.2)	35.9 (1.0)	38.0 (1.0)	60.8 (2.0)	35.5 (0.8)	47.0 (1.2)	46.9 (1.1)	49.2 (1.4)	52.8 (1.3)
Tb	6.3 (0.2)	5.5 (0.2)	6.0 (0.2)	9.3 (0.2)	5.4 (0.2)	7.4 (0.2)	7.4 (0.2)	7.5 (0.2)	7.7 (0.2)
Dy	37.7 (1.1)	35.2 (1.1)	37.8 (1.1)	57.4 (1.5)	33.3 (0.6)	45.9 (0.8)	46.0 (1.0)	45.6 (1.2)	46.6 (1.0)
Ho	7.1 (0.2)	6.8 (0.2)	7.6 (0.2)	10.8 (0.3)	6.0 (0.1)	8.5 (0.2)	8.4 (0.2)	8.6 (0.2)	8.7 (0.2)
Er	15.9 (0.6)	15.6 (0.5)	18.6 (0.4)	24.5 (0.6)	13.0 (0.3)	19.2 (0.4)	18.4 (0.4)	18.7 (0.6)	19.2 (0.4)
Tm	1.6 (0.1)	1.6 (0.0)	2.1 (0.1)	2.4 (0.1)	1.2 (0.0)	1.8 (0.1)	1.8 (0.0)	1.8 (0.1)	1.9 (0.1)
Yb	7.2 (0.4)	7.6 (0.3)	10.3 (0.3)	11.0 (0.3)	5.1 (0.2)	7.5 (0.2)	7.3 (0.3)	8.4 (0.3)	7.7 (0.2)
Lu	0.8 (0.0)	1.0 (0.0)	1.3 (0.1)	1.3 (0.0)	0.6 (0.0)	0.9 (0.0)	0.9 (0.0)	1.0 (0.0)	1.0 (0.0)
∑REE + Y	420 (4)	328 (2)	354 (2)	593 (4)	326 (2)	407 (2)	397 (2)	481 (3)	496 (2)
$(La/Lu)_{CN}$	1.84 (0.61)	0.29 (0.08)	0.21 (0.06)	0.78 (0.20)	0.88 (0.24)	0.33 (0.09)	0.35 (0.09)	1.50 (0.38)	1.67 (0.38)
$(La/Sm)_{CN}$	0.38 (0.11)	0.08 (0.02)	0.09 (0.02)	0.17 (0.04)	0.16 (0.04)	0.07 (0.02)	0.07 (0.02)	0.34 (0.07)	0.35 (0.07)
$(La/Y)_{CN}$	0.65 (0.18)	0.13 (0.03)	0.12 (0.03)	0.28 (0.06)	0.27 (0.06)	0.10 (0.02)	0.11 (0.02)	0.57 (0.12)	0.59 (0.10)
$Eu_A = Eu/Eu^*$	0.23 (0.02)	0.24 (0.02)	0.24 (0.01)	0.25 (0.02)	0.23 (0.01)	0.21 (0.01)	0.20 (0.01)	0.24 (0.01)	0.23 (0.01)
$Ce_A = Ce/Ce^*$	1.04 (0.09)	0.87 (0.07)	0.87 (0.07)	0.99 (0.06)	0.99 (0.06)	0.84 (0.05)	0.87 (0.06)	1.00 (0.05)	1.01 (0.05)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_51	UK#4_52	UK#4_53	UK#4_54	UK#4_55	UK#4_56	UK#4_57	UK#4_58	UK#4_59
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	12.6 (0.4)	14.5 (0.5)	17.4 (0.6)	26.3 (4.8)	19.8 (0.6)	17.7 (0.5)	15.8 (0.6)	12.7 (0.5)	12.3 (0.5)
Fe	≤ LOD	≤ LOD	≤ LOD	104 (51)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	6 (13)	13 (18)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	6 (7)	4 (1)	≤ LOD	≤ LOD	3 (3)	6 (7)	≤ LOD
As	24 (1)	63 (2)	55 (2)	51 (4)	41 (3)	32 (1)	39 (2)	56 (3)	78 (6)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	63.9 (1.2)	65.1 (1.2)	59.7 (1.0)	70.8 (1.3)	69.4 (1.2)	59.3 (1.1)	61.8 (0.9)	57.6 (1.0)	76.8 (1.0)
Y	59.0 (1.1)	278.2 (4.1)	455.3 (8.1)	445.0 (9.5)	138.8 (2.2)	167.8 (2.9)	153.7 (1.7)	312.9 (9.4)	433.0 (13.0)
Nb	36 (1)	111 (2)	193 (3)	75 (2)	33 (1)	37 (1)	57 (1)	78 (7)	47 (1)
Mo	530 (10)	610 (11)	180 (4)	140 (3)	549 (10)	549 (11)	613 (11)	156 (3)	164 (2)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	717000 (16000)	726000 (11000)	738000 (16000)	715000 (13000)	724000 (15000)	722000 (13000)	713000 (11000)	711000 (17000)	729100 (9100)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	3.4 (0.1)	7.9 (0.2)	4.1 (0.1)	2.8 (0.1)	3.0 (0.1)	8.4 (0.2)	11.6 (0.4)	1.3 (0.1)	2.6 (0.1)
Ce	13.5 (0.4)	38.6 (0.6)	19.7 (0.5)	13.8 (0.3)	16.0 (0.3)	38.9 (0.7)	48.8 (1.4)	7.7 (0.3)	14.2 (0.6)
Pr	2.6 (0.1)	8.6 (0.2)	4.4 (0.1)	3.3 (0.1)	4.2 (0.1)	8.0 (0.2)	9.5 (0.3)	2.2 (0.1)	3.5 (0.1)
Nd	18.1 (0.5)	64.5 (1.0)	33.9 (0.8)	26.2 (0.7)	39.3 (1.0)	56.8 (1.2)	65.6 (1.6)	22.6 (0.6)	29.7 (1.0)
Sm	8.1 (0.3)	35.1 (0.7)	24.5 (0.5)	19.7 (0.6)	21.6 (0.6)	27.8 (0.7)	29.7 (0.7)	17.7 (0.6)	20.6 (0.6)
Eu	1.04 (0.05)	3.50 (0.10)	4.82 (0.12)	3.08 (0.10)	2.41 (0.09)	3.30 (0.11)	4.03 (0.11)	4.37 (0.10)	4.38 (0.11)
Gd	13.8 (0.4)	68.8 (1.1)	72.2 (1.4)	59.2 (1.2)	40.8 (0.9)	49.4 (1.0)	51.9 (1.0)	52.8 (2.0)	58.2 (1.5)
Tb	2.3 (0.1)	10.9 (0.2)	15.4 (0.3)	13.2 (0.3)	6.2 (0.1)	7.7 (0.2)	7.6 (0.1)	10.9 (0.4)	12.0 (0.3)
Dy	14.2 (0.4)	69.2 (1.3)	120.3 (2.7)	106.5 (2.2)	37.8 (0.8)	46.2 (1.1)	44.8 (0.8)	80.5 (3.1)	94.7 (2.8)
Ho	2.8 (0.1)	13.2 (0.3)	25.0 (0.5)	23.2 (0.4)	7.2 (0.2)	8.4 (0.2)	8.1 (0.2)	16.8 (0.6)	20.9 (0.5)
Er	6.7 (0.2)	29.9 (0.6)	55.8 (1.0)	53.6 (0.8)	16.4 (0.4)	18.8 (0.5)	17.1 (0.3)	38.6 (1.1)	50.4 (1.2)
Tm	0.7 (0.0)	2.8 (0.1)	4.7 (0.1)	4.7 (0.1)	1.6 (0.1)	1.8 (0.1)	1.5 (0.1)	3.4 (0.1)	4.9 (0.1)
Yb	3.3 (0.2)	12.1 (0.3)	16.5 (0.4)	18.1 (0.4)	7.0 (0.2)	6.9 (0.3)	5.9 (0.2)	13.1 (0.4)	20.5 (0.6)
Lu	≤ LOD	1.4 (0.1)	1.7 (0.1)	1.8 (0.1)	0.9 (0.0)	0.8 (0.0)	0.7 (0.0)	1.4 (0.1)	2.3 (0.1)
∑REE + Y	150 (1)	645 (2)	858 (3)	794 (3)	343 (2)	451 (2)	461 (3)	586 (4)	772 (4)
$(La/Lu)_{CN}$	0.82 (0.24)	0.57 (0.14)	0.24 (0.06)	0.16 (0.04)	0.35 (0.10)	1.06 (0.27)	1.70 (0.49)	0.09 (0.03)	0.12 (0.03)
$(La/Sm)_{CN}$	0.26 (0.07)	0.14 (0.03)	0.10 (0.02)	0.09 (0.02)	0.09 (0.02)	0.19 (0.04)	0.25 (0.06)	0.05 (0.01)	0.08 (0.02)
$(La/Y)_{CN}$	0.38 (0.08)	0.19 (0.04)	0.06 (0.01)	0.04 (0.01)	0.14 (0.03)	0.33 (0.06)	0.50 (0.11)	0.03 (0.01)	0.04 (0.01)
$Eu_A = Eu/Eu^*$	0.30 (0.02)	0.21 (0.01)	0.32 (0.02)	0.25 (0.01)	0.24 (0.01)	0.27 (0.01)	0.31 (0.01)	0.40 (0.03)	0.36 (0.02)
$Ce_A = Ce/Ce^*$	1.02 (0.07)	0.98 (0.05)	0.98 (0.06)	0.94 (0.06)	0.89 (0.06)	1.03 (0.06)	1.04 (0.07)	0.84 (0.06)	0.92 (0.07)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_60	UK#4_61	UK#4_62	UK#4_63	UK#4_64	UK#4_65	UK#4_66	UK#4_67	UK#4_68
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (4)	≤ LOD	≤ LOD	2 (2)	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	16.1 (0.8)	20.8 (0.8)	16.8 (0.6)	17.6 (0.6)	17.3 (0.8)	12.1 (0.4)	16.9 (0.7)	22.0 (1.8)	17.7 (0.6)
Fe	≤ LOD	180 (250)	≤ LOD	≤ LOD	390 (430)	≤ LOD	≤ LOD	200 (160)	90 (120)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5 (5)	≤ LOD
Cu	2 (1)	4 (3)	≤ LOD	3 (4)	9 (7)	≤ LOD	≤ LOD	13 (11)	2 (4)
Zn	≤ LOD	3 (2)	≤ LOD	14 (13)	790 (970)	3 (3)	3 (3)	1300 (1500)	30 (31)
As	59 (3)	27 (6)	34 (5)	29 (4)	62 (10)	71 (2)	32 (3)	75 (37)	35 (8)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	68.8 (1.0)	54.7 (1.3)	55.8 (0.9)	57.7 (1.0)	65.2 (0.9)	66.3 (1.2)	61.7 (1.2)	57.5 (1.2)	55.3 (1.0)
Y	340.6 (4.6)	33.4 (0.8)	126.7 (2.3)	124.2 (1.9)	135.4 (1.9)	159.1 (2.5)	103.3 (1.7)	39.8 (0.7)	52.0 (1.6)
Nb	63 (1)	20 (1)	55 (1)	37 (1)	112 (2)	152 (3)	34 (1)	23 (0)	32 (2)
Mo	148 (3)	555 (17)	558 (11)	575 (11)	690 (12)	706 (12)	490 (10)	535 (13)	523 (9)
Ag	17.9 (4.4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	727000 (13000)	735000 (15000)	723000 (13000)	742000 (15000)	728000 (12000)	745000 (14000)	736000 (14000)	736000 (14000)	742000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	1.5 (0.1)	4.9 (0.2)	3.2 (0.1)	2.3 (0.1)	6.8 (0.2)	10.6 (0.2)	2.4 (0.1)	3.6 (0.1)	4.7 (0.1)
Ce	8.8 (0.2)	15.8 (0.6)	19.0 (0.5)	12.2 (0.3)	40.2 (0.7)	60.3 (0.9)	12.7 (0.3)	12.8 (0.3)	16.5 (0.5)
Pr	2.6 (0.1)	2.6 (0.1)	5.1 (0.2)	3.3 (0.1)	9.1 (0.2)	12.6 (0.3)	3.3 (0.1)	2.3 (0.1)	2.9 (0.1)
Nd	23.7 (0.5)	14.7 (0.9)	42.0 (1.0)	31.3 (1.0)	60.8 (1.3)	80.5 (1.6)	30.2 (0.7)	14.9 (0.5)	19.2 (0.8)
Sm	16.6 (0.5)	5.0 (0.3)	21.7 (0.6)	18.8 (0.6)	21.3 (0.4)	27.0 (0.8)	14.3 (0.3)	6.1 (0.2)	8.4 (0.3)
Eu	3.77 (0.12)	0.73 (0.05)	2.27 (0.09)	1.93 (0.09)	2.85 (0.11)	3.63 (0.11)	1.87 (0.08)	0.84 (0.04)	1.03 (0.06)
Gd	47.8 (1.0)	7.8 (0.4)	39.2 (0.9)	36.0 (0.9)	32.5 (0.8)	38.3 (0.8)	25.2 (0.5)	9.6 (0.3)	14.2 (0.6)
Tb	9.9 (0.2)	1.2 (0.1)	5.9 (0.1)	5.5 (0.1)	5.0 (0.1)	5.9 (0.1)	4.0 (0.1)	1.6 (0.1)	2.2 (0.1)
Dy	77.0 (1.3)	7.8 (0.3)	34.8 (0.7)	33.8 (0.7)	32.8 (0.6)	38.3 (0.8)	26.4 (0.5)	9.7 (0.3)	13.3 (0.6)
Ho	17.2 (0.3)	1.5 (0.1)	6.4 (0.1)	6.2 (0.1)	6.7 (0.1)	7.6 (0.2)	5.1 (0.1)	1.8 (0.1)	2.4 (0.1)
Er	42.3 (0.7)	3.5 (0.2)	13.6 (0.3)	13.4 (0.3)	16.0 (0.3)	18.5 (0.4)	12.3 (0.3)	4.2 (0.2)	5.5 (0.2)
Tm	4.1 (0.1)	0.4 (0.0)	1.3 (0.1)	1.2 (0.0)	1.6 (0.0)	1.9 (0.1)	1.2 (0.0)	0.5 (0.0)	0.5 (0.0)
Yb	17.5 (0.4)	1.8 (0.1)	5.3 (0.2)	5.1 (0.2)	7.7 (0.2)	8.3 (0.3)	5.2 (0.2)	2.2 (0.1)	2.3 (0.1)
Lu	2.0 (0.1)	≤ LOD	0.6 (0.0)	0.6 (0.0)	1.0 (0.0)	1.1 (0.0)	0.7 (0.0)	≤ LOD	≤ LOD
∑REE + Y	615 (2)	101 (1)	327 (2)	296 (2)	380 (2)	473 (2)	248 (1)	110 (1)	145 (1)
$(La/Lu)_{CN}$	0.08 (0.02)	2.24 (0.82)	0.53 (0.16)	0.39 (0.12)	0.72 (0.18)	1.04 (0.27)	0.37 (0.10)	1.36 (0.45)	1.65 (0.55)
$(La/Sm)_{CN}$	0.06 (0.01)	0.61 (0.19)	0.09 (0.02)	0.08 (0.02)	0.20 (0.04)	0.25 (0.06)	0.11 (0.02)	0.37 (0.10)	0.35 (0.09)
$(La/Y)_{CN}$	0.03 (0.01)	0.97 (0.24)	0.17 (0.04)	0.13 (0.03)	0.33 (0.06)	0.44 (0.09)	0.15 (0.03)	0.60 (0.13)	0.60 (0.15)
$Eu_A = Eu/Eu^*$	0.38 (0.02)	0.35 (0.04)	0.23 (0.01)	0.22 (0.01)	0.33 (0.02)	0.34 (0.02)	0.30 (0.02)	0.33 (0.02)	0.29 (0.02)
$Ce_A = Ce/Ce^*$	0.83 (0.06)	1.05 (0.09)	0.89 (0.07)	0.87 (0.06)	1.02 (0.06)	1.07 (0.06)	0.89 (0.06)	1.02 (0.06)	1.04 (0.07)

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TABLE E4. *(continued)*

Sample (ppm)	UK#4_69	UK#4_70	UK#4_71	UK#4_72	UK#4_73	UK#4_74	UK#4_75
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (3)	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	18.4 (0.5)	20.6 (1.0)	22.5 (0.8)	18.7 (0.9)	11.8 (0.7)	11.3 (0.6)	13.9 (1.0)
Fe	57 (89)	340 (250)	60 (110)	3 (8)	790 (650)	2 (7)	34 (47)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	2 (2)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	27 (18)	5 (6)	≤ LOD	47 (30)	5 (7)	14 (10)
Zn	23 (32)	47 (47)	7 (6)	6 (8)	560 (590)	20 (22)	4 (4)
As	26 (1)	78 (22)	74 (17)	56 (2)	168 (34)	210 (140)	510 (510)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	55.0 (0.8)	63.9 (1.3)	84.5 (1.8)	90.7 (2.0)	76.8 (1.7)	64.2 (1.4)	70.7 (1.4)
Y	51.8 (1.2)	139.4 (2.8)	128.1 (2.1)	116.2 (2.2)	189.2 (3.8)	180.9 (3.8)	194.2 (3.7)
Nb	29 (1)	33 (1)	28 (1)	32 (1)	103 (2)	107 (2)	104 (2)
Mo	528 (8)	553 (10)	544 (11)	546 (11)	599 (30)	581 (12)	584 (10)
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	1.9 (1.2)	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	745000 (10000)	739000 (14000)	744000 (15000)	748000 (18000)	735000 (16000)	750000 (13000)	744000 (16000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
La	5.9 (0.1)	3.4 (0.1)	2.2 (0.1)	1.2 (0.0)	17.0 (0.4)	16.2 (0.3)	18.3 (0.4)
Ce	18.1 (0.4)	18.9 (0.4)	12.5 (0.3)	6.4 (0.2)	55.9 (1.1)	55.7 (1.2)	61.8 (1.2)
Pr	3.1 (0.1)	4.7 (0.1)	3.6 (0.1)	2.2 (0.1)	9.6 (0.2)	9.8 (0.2)	10.9 (0.3)
Nd	19.5 (0.5)	39.9 (1.0)	32.0 (0.9)	25.0 (0.6)	64.1 (1.2)	62.8 (1.1)	68.5 (1.6)
Sm	8.6 (0.3)	22.2 (0.6)	16.3 (0.5)	14.9 (0.5)	28.6 (0.7)	27.8 (0.6)	30.5 (1.0)
Eu	1.04 (0.05)	2.63 (0.12)	1.78 (0.07)	1.81 (0.07)	3.11 (0.10)	3.05 (0.08)	3.16 (0.09)
Gd	14.1 (0.5)	41.7 (1.2)	30.6 (0.8)	31.3 (0.8)	50.3 (1.0)	48.8 (1.1)	52.2 (1.3)
Tb	2.3 (0.1)	6.8 (0.1)	4.9 (0.2)	4.9 (0.1)	7.7 (0.2)	7.5 (0.2)	8.2 (0.2)
Dy	13.6 (0.4)	40.5 (0.9)	31.7 (0.8)	31.6 (0.8)	46.9 (1.2)	44.7 (0.9)	49.3 (1.1)
Ho	2.4 (0.1)	7.4 (0.2)	6.3 (0.2)	6.3 (0.1)	8.7 (0.2)	8.3 (0.2)	9.0 (0.2)
Er	5.4 (0.2)	16.2 (0.3)	15.7 (0.4)	15.8 (0.3)	19.5 (0.5)	18.5 (0.4)	19.8 (0.4)
Tm	0.5 (0.0)	1.5 (0.1)	1.8 (0.1)	1.8 (0.1)	1.9 (0.1)	1.8 (0.1)	1.9 (0.1)
Yb	2.4 (0.1)	6.6 (0.2)	9.4 (0.3)	9.2 (0.3)	8.3 (0.2)	7.8 (0.2)	8.2 (0.3)
Lu	≤ LOD	0.8 (0.0)	1.3 (0.0)	1.2 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)
∑REE + Y	149 (1)	353 (2)	298 (2)	270 (1)	512 (2)	495 (2)	537 (3)
$(La/Lu)_{CN}$	1.98 (0.60)	0.46 (0.13)	0.18 (0.05)	0.10 (0.03)	1.74 (0.42)	1.71 (0.39)	1.94 (0.49)
$(La/Sm)_{CN}$	0.43 (0.10)	0.10 (0.02)	0.09 (0.02)	0.05 (0.01)	0.37 (0.08)	0.37 (0.07)	0.38 (0.09)
$(La/Y)_{CN}$	0.75 (0.15)	0.16 (0.03)	0.12 (0.03)	0.07 (0.02)	0.60 (0.12)	0.60 (0.12)	0.63 (0.13)
$Eu_A = Eu/Eu^*$	0.28 (0.02)	0.26 (0.02)	0.24 (0.02)	0.25 (0.02)	0.25 (0.01)	0.25 (0.01)	0.24 (0.01)
$Ce_A = Ce/Ce^*$	1.01 (0.05)	0.94 (0.05)	0.83 (0.06)	0.70 (0.05)	1.03 (0.05)	1.03 (0.06)	1.02 (0.05)

TABLE E5. Major and trace element compositions of scheelite from UK #5 (MWS).

Sample (ppm)	UK#5_1	UK#5_2	UK#5_4	UK#5_5	UK#5_6	UK#5_7	UK#5_8	UK#5_9	UK#5_10
Li	≤ LOD	≤ LOD	2 (1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	4.2 (3.0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	5.0 (0.4)	1.2 (0.6)
Fe	25 (38)	≤ LOD	47 (18)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (4)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	3 (4)	2 (3)	2 (3)	≤ LOD	≤ LOD	19 (31)	≤ LOD	≤ LOD	≤ LOD
As	11 (3)	6 (0)	11 (1)	7 (0)	6 (0)	7 (1)	10 (3)	7 (0)	9 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	5430.0 (130.0)	5327.0 (85.0)	2212.0 (52.0)	5350.0 (150.0)	6100.0 (220.0)	7360.0 (170.0)	5400.0 (97.0)	6880.0 (130.0)	6010.0 (130.0)
Y	78.2 (2.6)	59.1 (1.0)	411.5 (8.8)	143.7 (3.4)	68.1 (2.6)	223.0 (24.0)	324.8 (9.6)	140.3 (3.9)	46.3 (1.8)
Nb	≤ LOD	≤ LOD	2 (0)	1 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	709000 (17000)	708000 (16000)	728000 (18000)	713000 (13000)	710000 (13000)	686000 (13000)	710000 (14000)	718000 (14000)	708000 (13000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)	≤ LOD	≤ LOD	≤ LOD	2 (0)
La	24.8 (0.6)	14.5 (0.3)	14.8 (0.5)	17.4 (0.8)	12.2 (0.3)	23.9 (1.3)	54.1 (1.0)	13.1 (0.3)	12.7 (0.4)
Ce	35.0 (0.9)	16.1 (0.3)	95.3 (2.0)	39.1 (1.1)	22.2 (0.7)	61.3 (5.9)	142.2 (5.8)	37.0 (1.1)	16.6 (0.8)
Pr	3.1 (0.2)	1.4 (0.0)	21.4 (0.6)	7.6 (0.2)	2.8 (0.3)	7.2 (0.7)	16.7 (1.1)	6.3 (0.2)	1.6 (0.2)
Nd	11.4 (1.1)	5.4 (0.3)	131.9 (3.7)	52.5 (1.4)	11.9 (1.5)	26.9 (2.8)	67.2 (5.1)	34.1 (1.5)	6.3 (0.8)
Sm	3.4 (0.5)	1.4 (0.1)	56.2 (1.9)	25.8 (0.9)	3.3 (0.5)	6.9 (0.6)	18.9 (1.7)	15.3 (1.0)	1.8 (0.3)
Eu	2.65 (0.19)	1.26 (0.07)	33.31 (0.77)	8.23 (0.30)	2.59 (0.42)	5.78 (0.54)	11.63 (0.69)	8.98 (0.51)	1.78 (0.24)
Gd	5.2 (0.7)	2.1 (0.1)	77.0 (2.4)	37.5 (1.3)	5.4 (0.9)	10.7 (1.1)	26.0 (2.3)	23.3 (1.6)	2.6 (0.4)
Tb	1.0 (0.1)	0.5 (0.0)	14.5 (0.5)	6.8 (0.2)	1.0 (0.1)	2.4 (0.2)	5.0 (0.4)	4.5 (0.3)	0.5 (0.1)
Dy	7.5 (0.8)	4.1 (0.2)	96.3 (3.0)	43.0 (1.1)	7.8 (0.9)	20.7 (2.2)	38.1 (3.0)	29.3 (1.3)	3.9 (0.5)
Ho	1.5 (0.1)	1.0 (0.1)	16.6 (0.4)	7.0 (0.2)	1.8 (0.2)	5.1 (0.6)	7.9 (0.6)	5.2 (0.2)	0.8 (0.1)
Er	5.3 (0.4)	3.8 (0.1)	38.7 (0.9)	14.7 (0.4)	5.4 (0.3)	18.4 (2.1)	24.7 (1.5)	13.1 (0.5)	2.9 (0.2)
Tm	0.9 (0.0)	0.9 (0.0)	3.9 (0.1)	1.6 (0.1)	0.9 (0.1)	3.3 (0.4)	4.0 (0.2)	1.7 (0.1)	0.6 (0.0)
Yb	7.6 (0.2)	7.8 (0.3)	17.0 (0.5)	8.8 (0.3)	6.7 (0.3)	21.3 (2.2)	24.4 (0.6)	9.9 (0.4)	5.3 (0.2)
Lu	0.9 (0.0)	1.1 (0.0)	1.4 (0.1)	1.0 (0.0)	0.9 (0.0)	2.5 (0.2)	2.4 (0.1)	1.2 (0.0)	0.7 (0.0)
∑REE + Y	189 (2)	120 (1)	1030 (6)	415 (3)	153 (2)	439 (8)	768 (9)	343 (3)	104 (1)
$(La/Lu)_{CN}$	2.75 (0.73)	1.38 (0.35)	1.11 (0.31)	1.88 (0.56)	1.41 (0.37)	1.00 (0.39)	2.29 (0.54)	1.16 (0.29)	1.81 (0.55)
$(La/Sm)_{CN}$	4.56 (1.86)	6.39 (2.09)	0.17 (0.04)	0.42 (0.12)	2.33 (0.98)	2.18 (0.84)	1.79 (0.59)	0.54 (0.16)	4.49 (1.91)
$(La/Y)_{CN}$	2.11 (0.51)	1.63 (0.32)	0.24 (0.05)	0.81 (0.21)	1.19 (0.31)	0.71 (0.29)	1.11 (0.24)	0.62 (0.14)	1.82 (0.47)
$Eu_A = Eu/Eu^*$	1.91 (0.40)	2.21 (0.27)	1.54 (0.09)	0.80 (0.05)	1.85 (0.53)	2.04 (0.35)	1.59 (0.23)	1.44 (0.16)	2.51 (0.63)
$Ce_A = Ce/Ce^*$	0.83 (0.05)	0.69 (0.04)	1.04 (0.07)	0.82 (0.06)	0.89 (0.08)	1.11 (0.17)	1.13 (0.09)	0.97 (0.06)	0.77 (0.07)

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TABLE E5. *(continued)*

Sample (ppm)	UK#5_11	UK#5_12	UK#5_13	UK#5_14	UK#5_15	UK#5_16	UK#5_17	UK#5_18	UK#5_19
Li	≤ LOD	2 (1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	1.1 (0.4)	2.6 (0.4)	3.5 (0.3)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	170 (230)	≤ LOD	≤ LOD	≤ LOD	6 (24)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	3 (4)	≤ LOD	3 (4)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	3 (4)	≤ LOD
Zn	≤ LOD	6 (9)	12 (10)	≤ LOD	2 (3)	9 (8)	≤ LOD	2 (2)	5 (7)
As	9 (3)	11 (2)	10 (2)	7 (0)	6 (1)	12 (4)	8 (2)	7 (1)	9 (2)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	4130.0 (86.0)	4760.0 (90.0)	6840.0 (150.0)	5330.0 (100.0)	5110.0 (110.0)	4700.0 (100.0)	5600.0 (120.0)	6650.0 (140.0)	4994.0 (90.0)
Y	59.9 (3.4)	60.3 (4.3)	130.7 (9.5)	73.9 (2.7)	24.6 (1.0)	114.9 (2.6)	73.8 (3.4)	164.1 (6.8)	181.0 (2.8)
Nb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	717000 (15000)	703000 (12000)	701000 (14000)	720000 (16000)	711000 (16000)	731000 (18000)	706000 (14000)	696000 (18000)	719000 (16000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	≤ LOD	3 (0)	≤ LOD	2 (0)	≤ LOD	2 (0)	2 (0)	≤ LOD
La	6.4 (0.2)	9.5 (0.3)	19.6 (0.6)	24.4 (0.6)	8.9 (0.3)	13.7 (0.7)	23.6 (0.6)	24.5 (0.5)	13.2 (0.3)
Ce	17.0 (1.1)	18.0 (1.4)	39.7 (2.7)	30.7 (1.0)	8.9 (0.3)	34.8 (1.0)	30.0 (1.0)	46.8 (1.7)	50.6 (1.0)
Pr	3.3 (0.3)	2.3 (0.3)	4.6 (0.3)	2.4 (0.1)	0.9 (0.0)	5.0 (0.2)	2.5 (0.1)	5.0 (0.3)	8.0 (0.2)
Nd	19.6 (1.7)	11.4 (1.3)	18.7 (1.2)	8.2 (0.4)	4.0 (0.2)	23.9 (1.1)	8.6 (0.3)	21.1 (1.2)	39.2 (1.4)
Sm	8.4 (0.7)	4.3 (0.6)	5.8 (0.3)	2.4 (0.2)	1.5 (0.1)	9.0 (0.5)	2.2 (0.1)	7.3 (0.5)	14.5 (1.0)
Eu	3.54 (0.24)	2.50 (0.28)	3.86 (0.24)	1.68 (0.08)	0.84 (0.05)	4.95 (0.22)	1.57 (0.08)	3.82 (0.20)	8.09 (0.37)
Gd	12.6 (1.0)	6.5 (0.8)	8.4 (0.4)	3.4 (0.2)	2.1 (0.2)	13.4 (0.7)	3.4 (0.3)	11.1 (0.7)	21.8 (1.2)
Tb	2.3 (0.2)	1.2 (0.1)	1.7 (0.1)	0.7 (0.0)	0.4 (0.0)	2.7 (0.1)	0.7 (0.0)	2.1 (0.1)	4.3 (0.2)
Dy	15.0 (1.1)	8.4 (1.0)	14.3 (0.8)	5.7 (0.2)	2.8 (0.2)	18.2 (0.8)	5.3 (0.3)	16.1 (0.9)	32.6 (1.0)
Ho	2.6 (0.2)	1.7 (0.2)	3.3 (0.2)	1.2 (0.1)	0.6 (0.0)	3.5 (0.1)	1.2 (0.1)	3.6 (0.2)	6.5 (0.1)
Er	6.1 (0.5)	4.9 (0.4)	10.5 (0.8)	4.5 (0.2)	1.6 (0.1)	10.1 (0.3)	5.0 (0.2)	12.4 (0.7)	18.4 (0.4)
Tm	0.7 (0.1)	0.8 (0.1)	1.9 (0.2)	1.0 (0.1)	≤ LOD	1.5 (0.0)	1.0 (0.1)	2.3 (0.1)	2.3 (0.1)
Yb	4.1 (0.2)	5.5 (0.2)	12.7 (0.8)	9.2 (0.4)	2.9 (0.2)	8.6 (0.3)	9.1 (0.5)	16.3 (0.5)	11.6 (0.4)
Lu	≤ LOD	0.7 (0.0)	1.7 (0.1)	1.2 (0.1)	0.5 (0.0)	0.9 (0.1)	1.3 (0.1)	2.0 (0.1)	1.1 (0.0)
∑REE + Y	162 (3)	138 (2)	277 (3)	170 (1)	61 (1)	265 (2)	169 (1)	339 (3)	413 (3)
$(La/Lu)_{CN}$	1.42 (0.40)	1.41 (0.44)	1.19 (0.35)	2.04 (0.54)	1.90 (0.53)	1.58 (0.54)	1.86 (0.57)	1.26 (0.29)	1.25 (0.31)
$(La/Sm)_{CN}$	0.48 (0.16)	1.38 (0.56)	2.14 (0.59)	6.33 (1.88)	3.71 (1.30)	0.96 (0.32)	6.73 (2.00)	2.10 (0.60)	0.57 (0.17)
$(La/Y)_{CN}$	0.71 (0.21)	1.04 (0.34)	1.00 (0.32)	2.20 (0.55)	2.41 (0.63)	0.79 (0.22)	2.13 (0.56)	0.99 (0.24)	0.49 (0.09)
$Eu_A = Eu/Eu^*$	1.04 (0.14)	1.44 (0.30)	1.68 (0.15)	1.77 (0.17)	1.43 (0.20)	1.37 (0.12)	1.74 (0.20)	1.28 (0.13)	1.38 (0.14)
$Ce_A = Ce/Ce^*$	0.88 (0.10)	0.90 (0.12)	0.97 (0.10)	0.78 (0.05)	0.62 (0.04)	1.01 (0.08)	0.77 (0.05)	0.97 (0.06)	1.15 (0.06)

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TABLE E5. *(continued)*

Sample (ppm)	UK#5_20	UK#5_21	UK#5_22	UK#5_23	UK#5_24	UK#5_25	UK#5_26	UK#5_27	UK#5_28
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	115 (16)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	9 (4)	3 (1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Fe	13 (26)	≤ LOD	20 (5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	21 (34)	4 (7)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	4 (3)	10 (9)	≤ LOD
As	7 (1)	8 (0)	8 (0)	8 (2)	7 (1)	7 (0)	10 (4)	7 (1)	6 (1)
Rb	≤ LOD	≤ LOD	0.8 (0.1)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	4804.0 (72.0)	5580.0 (180.0)	6100.0 (130.0)	6560.0 (150.0)	4960.0 (180.0)	6070.0 (110.0)	7570.0 (150.0)	4404.0 (85.0)	4740.0 (120.0)
Y	278.1 (6.5)	107.5 (7.8)	430.6 (9.8)	100.4 (2.1)	182.2 (7.3)	129.5 (7.7)	141.0 (3.1)	126.3 (2.6)	118.4 (3.2)
Nb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	720000 (11000)	698000 (17000)	700000 (14000)	697000 (14000)	726000 (13000)	710000 (14000)	698000 (14000)	717000 (15000)	726000 (14000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	2 (0)	≤ LOD	2 (0)	≤ LOD	2 (0)	2 (0)	≤ LOD	≤ LOD
La	31.1 (0.8)	19.8 (0.5)	31.2 (0.5)	14.7 (0.3)	20.2 (0.5)	31.9 (1.4)	20.8 (0.7)	25.9 (0.7)	26.3 (0.8)
Ce	91.0 (1.9)	36.6 (2.7)	116.2 (2.5)	25.7 (0.6)	56.8 (1.9)	48.4 (2.8)	37.4 (1.1)	35.3 (0.8)	35.2 (0.9)
Pr	10.4 (0.2)	4.1 (0.4)	17.5 (0.4)	3.0 (0.2)	6.7 (0.2)	4.2 (0.2)	4.1 (0.1)	3.7 (0.1)	2.8 (0.1)
Nd	37.3 (0.9)	16.1 (1.5)	82.7 (2.3)	13.8 (1.3)	24.5 (0.9)	13.6 (1.0)	17.9 (0.7)	16.4 (0.5)	9.6 (0.7)
Sm	8.7 (0.3)	4.6 (0.5)	26.9 (0.8)	5.4 (0.6)	5.8 (0.3)	2.6 (0.3)	5.9 (0.4)	5.7 (0.3)	3.1 (0.4)
Eu	7.26 (0.17)	3.53 (0.32)	14.47 (0.34)	3.71 (0.31)	4.76 (0.19)	2.44 (0.19)	3.74 (0.14)	3.71 (0.12)	2.75 (0.18)
Gd	13.2 (0.4)	6.5 (0.7)	41.5 (1.2)	9.0 (0.9)	8.6 (0.4)	3.8 (0.4)	9.3 (0.5)	8.5 (0.3)	4.5 (0.6)
Tb	3.0 (0.1)	1.5 (0.2)	8.9 (0.3)	1.7 (0.2)	2.0 (0.1)	0.9 (0.1)	1.8 (0.1)	1.7 (0.1)	1.0 (0.1)
Dy	26.8 (0.6)	10.9 (1.1)	68.9 (1.7)	12.5 (1.0)	17.9 (0.6)	8.0 (0.7)	13.6 (0.7)	12.6 (0.4)	7.4 (0.6)
Ho	6.7 (0.2)	2.5 (0.3)	14.7 (0.4)	2.4 (0.1)	4.4 (0.2)	2.1 (0.2)	2.9 (0.1)	2.6 (0.1)	1.7 (0.1)
Er	23.2 (0.5)	8.7 (0.9)	43.7 (1.3)	7.7 (0.3)	15.1 (0.5)	8.6 (0.6)	10.2 (0.3)	8.4 (0.3)	6.7 (0.3)
Tm	3.8 (0.1)	1.5 (0.1)	6.1 (0.2)	1.2 (0.1)	2.5 (0.1)	1.8 (0.1)	1.9 (0.1)	1.6 (0.1)	1.6 (0.1)
Yb	23.0 (0.7)	10.3 (0.5)	32.3 (0.7)	8.2 (0.3)	14.9 (0.7)	13.7 (0.6)	13.9 (0.4)	13.3 (0.4)	13.3 (0.6)
Lu	2.3 (0.1)	1.3 (0.1)	3.3 (0.1)	1.0 (0.0)	1.5 (0.1)	1.8 (0.1)	1.6 (0.1)	1.7 (0.1)	1.6 (0.1)
∑REE + Y	566 (3)	235 (4)	939 (4)	210 (2)	368 (2)	273 (4)	286 (2)	267 (1)	236 (2)
$(La/Lu)_{CN}$	1.37 (0.34)	1.59 (0.47)	0.99 (0.22)	1.61 (0.40)	1.35 (0.35)	1.84 (0.53)	1.31 (0.36)	1.57 (0.40)	1.69 (0.48)
$(La/Sm)_{CN}$	2.25 (0.54)	2.71 (0.99)	0.73 (0.16)	1.73 (0.62)	2.17 (0.57)	7.69 (2.96)	2.23 (0.72)	2.84 (0.78)	5.33 (2.21)
$(La/Y)_{CN}$	0.74 (0.16)	1.23 (0.39)	0.48 (0.10)	0.98 (0.20)	0.74 (0.18)	1.64 (0.53)	0.98 (0.23)	1.36 (0.30)	1.48 (0.35)
Eu_A = Eu/Eu*	2.06 (0.11)	1.97 (0.35)	1.31 (0.07)	1.61 (0.28)	2.05 (0.16)	2.37 (0.39)	1.53 (0.16)	1.61 (0.12)	2.24 (0.48)
Ce_A = Ce/Ce*	1.21 (0.06)	0.93 (0.10)	1.17 (0.06)	0.89 (0.06)	1.17 (0.07)	0.88 (0.09)	0.92 (0.06)	0.77 (0.05)	0.81 (0.05)

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TABLE E5. *(continued)*

Sample (ppm)	UK#5_29	UK#5_30	UK#5_31	UK#5_32	UK#5_33	UK#5_34	UK#5_35	UK#5_36	UK#5_37
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	17 (11)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	1.9 (0.6)	≤ LOD	≤ LOD	2.1 (0.3)	≤ LOD	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	2 (6)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	7 (10)	3 (5)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	9 (9)	6 (8)	≤ LOD
As	9 (4)	7 (1)	7 (1)	12 (3)	8 (1)	15 (12)	8 (2)	7 (2)	6 (0)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	7660.0 (160.0)	8150.0 (130.0)	6130.0 (110.0)	4686.0 (84.0)	4940.0 (140.0)	6830.0 (140.0)	4930.0 (100.0)	5120.0 (110.0)	5400.0 (130.0)
Y	32.7 (1.2)	105.9 (4.3)	69.8 (2.1)	407.0 (11.0)	703.0 (40.0)	110.4 (3.6)	143.3 (4.8)	144.2 (3.3)	76.5 (4.3)
Nb	≤ LOD	≤ LOD	≤ LOD	1 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	696000 (15000)	714000 (16000)	705000 (16000)	718000 (17000)	708000 (17000)	706000 (15000)	710000 (16000)	715000 (14000)	707000 (18000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	3 (0)	2 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (0)
La	18.3 (0.3)	18.0 (0.5)	10.5 (0.4)	17.8 (0.4)	70.7 (4.2)	18.0 (0.5)	14.9 (0.4)	17.8 (0.5)	13.7 (0.5)
Ce	12.0 (0.4)	31.6 (1.5)	18.7 (0.7)	93.4 (2.5)	252.0 (14.0)	30.6 (1.1)	42.3 (1.6)	40.4 (1.0)	23.0 (1.2)
Pr	0.5 (0.0)	3.2 (0.2)	2.1 (0.1)	16.6 (0.5)	32.7 (1.6)	3.1 (0.1)	5.8 (0.2)	4.5 (0.1)	2.5 (0.1)
Nd	1.0 (0.2)	10.4 (0.8)	7.9 (0.5)	83.1 (2.9)	131.5 (5.1)	11.5 (0.5)	25.5 (1.0)	16.7 (0.6)	9.7 (0.5)
Sm	≤ LOD	2.3 (0.2)	2.1 (0.2)	28.1 (1.3)	31.4 (1.4)	3.1 (0.2)	7.6 (0.3)	4.9 (0.2)	2.9 (0.2)
Eu	0.32 (0.05)	2.23 (0.16)	1.68 (0.08)	15.12 (0.47)	19.36 (0.95)	2.52 (0.12)	4.98 (0.20)	3.84 (0.16)	2.19 (0.10)
Gd	0.3 (0.1)	3.4 (0.3)	3.5 (0.3)	43.8 (1.7)	44.2 (1.8)	4.6 (0.3)	11.5 (0.5)	7.4 (0.3)	4.3 (0.3)
Tb	≤ LOD	0.8 (0.1)	0.8 (0.1)	9.4 (0.4)	9.4 (0.3)	1.0 (0.0)	2.5 (0.1)	1.6 (0.0)	0.9 (0.1)
Dy	0.7 (0.1)	7.4 (0.5)	6.8 (0.3)	74.3 (2.6)	78.1 (3.0)	9.3 (0.4)	19.8 (0.7)	13.8 (0.4)	7.5 (0.4)
Ho	≤ LOD	1.9 (0.1)	1.6 (0.1)	16.0 (0.6)	17.5 (0.8)	2.1 (0.1)	4.3 (0.2)	3.2 (0.1)	1.7 (0.1)
Er	1.2 (0.1)	7.0 (0.4)	5.7 (0.3)	45.1 (1.3)	56.7 (2.4)	7.9 (0.3)	13.1 (0.5)	11.4 (0.4)	5.8 (0.4)
Tm	0.4 (0.0)	1.4 (0.1)	1.0 (0.0)	5.7 (0.2)	8.9 (0.5)	1.5 (0.1)	1.9 (0.1)	2.0 (0.1)	1.1 (0.1)
Yb	5.7 (0.2)	10.9 (0.4)	7.1 (0.3)	27.3 (0.8)	52.8 (2.6)	12.8 (0.5)	10.4 (0.4)	13.1 (0.4)	7.5 (0.4)
Lu	1.0 (0.0)	1.4 (0.1)	0.9 (0.0)	2.4 (0.1)	5.0 (0.3)	1.6 (0.1)	1.1 (0.0)	1.4 (0.1)	0.9 (0.0)
∑REE + Y	75 (1)	208 (2)	140 (1)	885 (5)	1513 (16)	220 (2)	309 (2)	286 (2)	160 (2)
$(La/Lu)_{CN}$	1.93 (0.48)	1.34 (0.36)	1.23 (0.37)	0.78 (0.19)	1.46 (0.48)	1.17 (0.31)	1.37 (0.34)	1.32 (0.35)	1.56 (0.47)
$(La/Sm)_{CN}$	54.10 (31.03)	4.98 (1.79)	3.11 (1.02)	0.40 (0.10)	1.41 (0.46)	3.68 (1.11)	1.23 (0.32)	2.29 (0.62)	2.93 (0.91)
$(La/Y)_{CN}$	3.72 (0.87)	1.13 (0.30)	1.00 (0.26)	0.29 (0.06)	0.67 (0.23)	1.09 (0.27)	0.69 (0.17)	0.82 (0.19)	1.19 (0.37)
$Eu_A = Eu/Eu^*$	3.99 (1.73)	2.43 (0.39)	1.87 (0.24)	1.30 (0.09)	1.58 (0.13)	2.04 (0.20)	1.62 (0.12)	1.94 (0.15)	1.87 (0.19)
$Ce_A = Ce/Ce^*$	0.47 (0.03)	0.93 (0.08)	0.91 (0.07)	1.18 (0.08)	1.25 (0.13)	0.91 (0.06)	1.09 (0.08)	1.06 (0.06)	0.89 (0.08)

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TABLE E5. *(continued)*

Sample (ppm)	UK#5_38	UK#5_39	UK#5_40	UK#5_41	UK#5_42	UK#5_43	UK#5_44	UK#5_45	UK#5_46
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2 (1)	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	415 (45)	110 (28)	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	6 (1)	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	≤ LOD	≤ LOD	1.1 (0.4)	≤ LOD	4.2 (0.5)	3.3 (0.4)	2.5 (0.4)	≤ LOD
Fe	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	259 (82)	27 (6)	88 (46)	11 (8)
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	≤ LOD	≤ LOD	10 (11)	≤ LOD	2 (3)	≤ LOD	≤ LOD	≤ LOD	5 (7)
As	22 (18)	6 (0)	13 (8)	7 (1)	9 (3)	37 (7)	10 (1)	18 (5)	8 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	2.5 (0.3)	0.7 (0.2)	≤ LOD	≤ LOD
Sr	3920.0 (91.0)	6660.0 (140.0)	6910.0 (180.0)	5630.0 (120.0)	4910.0 (110.0)	4550.0 (190.0)	5930.0 (290.0)	5580.0 (110.0)	5190.0 (140.0)
Y	71.1 (6.4)	93.7 (2.2)	84.9 (2.5)	91.8 (1.7)	248.9 (5.9)	174.0 (16.0)	91.0 (11.0)	37.3 (3.6)	170.8 (6.1)
Nb	1 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	719000 (16000)	710000 (14000)	691000 (19000)	717000 (15000)	714000 (19000)	694000 (13000)	699000 (19000)	702000 (14000)	709000 (15000)
Th	≤ LOD	3 (0)	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	3 (0)	3 (0)	2 (0)	≤ LOD	≤ LOD	≤ LOD	2 (0)	≤ LOD
La	7.2 (0.3)	25.3 (0.5)	20.1 (0.4)	18.5 (0.4)	16.6 (0.4)	17.4 (0.6)	8.3 (0.8)	8.0 (0.6)	19.4 (0.5)
Ce	20.2 (1.8)	28.5 (0.6)	20.6 (0.5)	29.8 (0.7)	72.4 (2.2)	46.2 (4.7)	26.3 (2.9)	11.2 (1.0)	53.2 (1.4)
Pr	2.9 (0.3)	2.7 (0.1)	2.4 (0.1)	3.4 (0.1)	12.3 (0.5)	9.1 (1.0)	5.1 (0.7)	1.7 (0.2)	7.5 (0.2)
Nd	13.2 (1.4)	11.5 (0.5)	12.6 (0.5)	16.2 (0.6)	65.9 (3.5)	61.8 (7.0)	33.1 (5.1)	9.3 (0.9)	36.9 (1.0)
Sm	3.9 (0.4)	3.6 (0.2)	5.2 (0.2)	5.5 (0.3)	25.2 (1.5)	35.8 (4.2)	16.6 (3.1)	4.4 (0.4)	12.7 (0.5)
Eu	2.89 (0.32)	2.79 (0.13)	2.59 (0.09)	2.98 (0.13)	13.51 (0.70)	12.20 (1.20)	8.80 (1.20)	1.99 (0.21)	8.08 (0.26)
Gd	5.6 (0.6)	5.6 (0.3)	7.7 (0.4)	8.0 (0.3)	37.1 (2.1)	53.8 (6.1)	23.4 (4.0)	6.8 (0.8)	19.3 (0.7)
Tb	1.3 (0.2)	1.1 (0.1)	1.4 (0.1)	1.6 (0.1)	7.4 (0.4)	9.6 (1.1)	4.1 (0.7)	1.3 (0.1)	3.7 (0.1)
Dy	10.0 (1.1)	8.3 (0.3)	9.5 (0.4)	11.9 (0.4)	53.0 (2.4)	57.0 (6.4)	25.5 (4.2)	7.6 (0.8)	27.5 (1.0)
Ho	2.1 (0.2)	1.8 (0.1)	1.7 (0.1)	2.4 (0.1)	9.8 (0.4)	8.7 (1.0)	3.9 (0.6)	1.3 (0.1)	5.5 (0.2)
Er	6.5 (0.7)	5.7 (0.2)	5.0 (0.2)	7.2 (0.3)	26.7 (1.0)	16.5 (1.7)	8.3 (1.2)	3.0 (0.3)	15.7 (0.4)
Tm	1.0 (0.1)	1.2 (0.0)	1.0 (0.0)	1.3 (0.1)	3.5 (0.1)	1.7 (0.2)	0.8 (0.1)	0.5 (0.1)	2.3 (0.1)
Yb	5.9 (0.5)	12.4 (0.4)	11.2 (0.4)	9.0 (0.3)	16.7 (0.5)	9.4 (0.6)	3.6 (0.4)	3.3 (0.4)	12.7 (0.5)
Lu	0.6 (0.0)	2.0 (0.1)	1.8 (0.1)	1.1 (0.1)	1.5 (0.0)	1.0 (0.0)	≤ LOD	≤ LOD	1.3 (0.1)
∑REE + Y	154 (3)	206 (1)	188 (1)	211 (1)	610 (6)	514 (13)	259 (9)	98 (2)	397 (2)
$(La/Lu)_{CN}$	1.17 (0.39)	1.34 (0.33)	1.16 (0.29)	1.67 (0.43)	1.19 (0.28)	1.73 (0.49)	2.38 (1.07)	1.76 (0.75)	1.52 (0.38)
$(La/Sm)_{CN}$	1.14 (0.44)	4.39 (1.22)	2.41 (0.60)	2.13 (0.56)	0.41 (0.12)	0.30 (0.12)	0.31 (0.16)	1.15 (0.45)	0.96 (0.24)
$(La/Y)_{CN}$	0.67 (0.24)	1.79 (0.37)	1.57 (0.35)	1.34 (0.27)	0.44 (0.10)	0.67 (0.24)	0.60 (0.28)	1.43 (0.58)	0.76 (0.19)
$Eu_A = Eu/Eu^*$	1.87 (0.35)	1.88 (0.18)	1.24 (0.10)	1.37 (0.11)	1.34 (0.13)	0.84 (0.16)	1.36 (0.39)	1.11 (0.20)	1.56 (0.10)
$Ce_A = Ce/Ce^*$	1.06 (0.16)	0.68 (0.04)	0.61 (0.03)	0.84 (0.05)	1.15 (0.09)	0.87 (0.15)	0.95 (0.20)	0.70 (0.11)	1.06 (0.06)

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TABLE E5. *(continued)*

Sample (ppm)	UK#5_47	UK#5_48	UK#5_49	UK#5_50
Li	≤ LOD	≤ LOD	≤ LOD	≤ LOD
B	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Na	≤ LOD	≤ LOD	≤ LOD	≤ LOD
K	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ti	≤ LOD	≤ LOD	≤ LOD	≤ LOD
V	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cr	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mn	≤ LOD	4.8 (0.4)	≤ LOD	≤ LOD
Fe	≤ LOD	≤ LOD	14 (45)	≤ LOD
Co	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ni	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Cu	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Zn	3 (3)	3 (4)	3 (3)	≤ LOD
As	8 (2)	6 (0)	9 (6)	9 (1)
Rb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sr	5810.0 (150.0)	9590.0 (260.0)	5430.0 (130.0)	5520.0 (260.0)
Y	187.3 (7.0)	76.9 (4.5)	176.5 (3.8)	150.0 (15.0)
Nb	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Mo	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Ag	≤ LOD	≤ LOD	≤ LOD	≤ LOD
Sn	≤ LOD	≤ LOD	≤ LOD	≤ LOD
W	709000 (19000)	676000 (14000)	729000 (16000)	705000 (17000)
Th	≤ LOD	≤ LOD	≤ LOD	≤ LOD
U	≤ LOD	2 (0)	≤ LOD	≤ LOD
La	20.1 (0.5)	22.8 (0.9)	28.3 (0.7)	15.1 (0.7)
Ce	51.4 (1.7)	24.3 (1.4)	55.7 (1.1)	49.8 (5.6)
Pr	6.4 (0.2)	1.7 (0.1)	6.8 (0.2)	7.7 (1.0)
Nd	25.7 (0.9)	4.8 (0.4)	29.7 (1.0)	36.0 (5.3)
Sm	6.9 (0.4)	0.8 (0.1)	9.5 (0.4)	10.5 (1.6)
Eu	5.62 (0.24)	1.08 (0.07)	10.10 (0.33)	11.80 (1.80)
Gd	10.9 (0.6)	1.5 (0.2)	14.4 (0.5)	16.4 (2.5)
Tb	2.5 (0.1)	0.3 (0.0)	2.8 (0.1)	3.2 (0.5)
Dy	20.6 (0.8)	3.3 (0.3)	21.7 (0.6)	24.2 (3.2)
Ho	4.8 (0.2)	1.0 (0.1)	4.6 (0.1)	4.9 (0.6)
Er	16.1 (0.6)	4.3 (0.3)	14.0 (0.4)	14.0 (1.5)
Tm	2.7 (0.1)	1.0 (0.1)	2.3 (0.1)	1.9 (0.2)
Yb	16.1 (0.7)	10.6 (0.5)	16.6 (0.5)	10.0 (0.5)
Lu	1.8 (0.1)	1.6 (0.1)	1.9 (0.1)	1.0 (0.1)
∑REE + Y	379 (2)	156 (2)	395 (2)	356 (9)
$(La/Lu)_{CN}$	1.17 (0.29)	1.51 (0.44)	1.56 (0.38)	1.50 (0.47)
$(La/Sm)_{CN}$	1.84 (0.52)	17.67 (7.67)	1.87 (0.48)	0.90 (0.40)
$(La/Y)_{CN}$	0.71 (0.18)	1.97 (0.62)	1.07 (0.23)	0.67 (0.26)
Eu_A = Eu/Eu*	1.97 (0.18)	2.94 (0.55)	2.62 (0.17)	2.72 (0.72)
Ce_A = Ce/Ce*	1.09 (0.07)	0.69 (0.07)	0.94 (0.05)	1.09 (0.21)